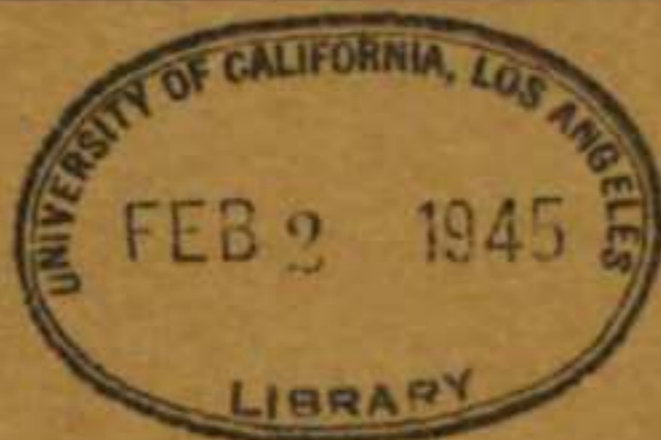


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TM 55-320

WAR DEPARTMENT TECHNICAL MANUAL



SMALL BOAT AND HARBOR CRAFT PREVENTIVE MAINTENANCE

WAR DEPARTMENT • NOVEMBER 1944

WAR DEPARTMENT TECHNICAL MANUAL

TM 55-320

SMALL BOAT AND
HARBOR CRAFT
PREVENTIVE
MAINTENANCE



WAR DEPARTMENT

NOVEMBER 1944

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TM 55-320, Small Boat and Harbor Craft Preventive Maintenance, is published for the information and guidance of all concerned.

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By ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

J. A. ULIO,
Major General,
The Adjutant General.

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For explanation of symbols, see FM 21-6.

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GENERAL

1. Purpose and Scope of Manual

a. PURPOSE. The purpose of this manual is to outline the procedures to be followed by boat crews and shore personnel when engaged in technical inspections and preventive maintenance of Transportation Corps marine craft.

b. SCOPE. The procedures outlined are general, and they apply to the structure and equipment of Transportation Corps marine craft of all types except propulsion units of steam vessels. Detailed instructions on technical inspections and preventive maintenance of specific marine engines and equipment are prescribed in specific technical manuals listed in FM 21-6.

2. Responsibilities for Maintenance of Marine Craft

Maintenance of marine craft is performed under the five echelon system, as follows:

a. FIRST ECHELON. Maintenance by this echelon includes elementary preventive maintenance services accomplished by members of the vessel's crew.

b. SECOND ECHELON. Maintenance by this echelon includes:

(1) Advanced preventive maintenance services and repairs that may be accomplished by technically qualified members of the vessel's crew.

(2) Advanced preventive maintenance services, inspections, and repairs made by personnel of a Harbor Craft Company (T/O & E 55-157), including replacement of minor assemblies, and emergency repairs and adjustments that do not involve the removal of superstructure or deck.

c. THIRD ECHELON. Maintenance by this echelon includes the removal and replacement of assemblies which do not involve the removal of the deck or superstructure, and repairs that may be made by Army marine repair shops or shops manned by Ship Repair Companies (T/O & E 55-47).

d. FOURTH ECHELON. Maintenance by this echelon includes maintenance and heavy repairs accomplished by shore personnel of Port Marine Maintenance Units (T/O & E 55-500).

e. FIFTH ECHELON. Maintenance by this echelon involves the rebuilding of major and accessory assemblies and sub-assemblies. Fifth echelon shops may be established at base depots, or use may be made of available local facilities, military or civilian.

3. Inspections

The primary objective of all inspections of marine equipment and of operating and servicing personnel is to improve the operating efficiency of military marine transportation. There are two basic types of inspection: command and technical.

a. COMMAND INSPECTIONS. Command inspections are made by unit commanders to determine the condition and adequacy of marine equipment, tools and supplies, the efficiency of personnel and their commands, and the economical assignment, pooling, and use of craft. This type of inspection may or may not be scheduled, and the exact nature and frequency of the inspection is left to the discretion of the commanding officer. Command inspections may be either formal or informal or may take the nature of spot checks.

b. TECHNICAL INSPECTIONS. Technical inspections are made by qualified personnel to determine whether or not a vessel should be continued in service, or withdrawn for overhaul or reclamation of component parts. These inspections are also a check on the condition of vessels when they are transferred, or when a report of survey is required. Technical inspections may take the form of examinations and tests to discover causes of difficulties encountered in operation.

4. Preventive Maintenance

a. PURPOSE. The purpose of preventive maintenance services performed by the first and second echelons is to keep the craft in satisfactory operating condition and to provide a means for the systematic detection and correction of possible or minor mechanical failures before they occur or develop into major defects.

b. FIRST ECHELON. (1) *Scheduled daily services.* Ordinarily it is the duty of the crew to re-

plenish fuel, oil, grease, water, and battery liquid, to clean the craft, to tighten loose bolts, nuts, and connections, to care for tools, equipment, and battery, to make emergency repairs as needed, and to check lubricant levels daily. These maintenance services are performed daily, before, during, and after operation, and weekly, as described in chapter 2.

(2) *Supervision.* The daily and especially the weekly maintenance services are performed under the direction of the section leader or chief engineer and under the supervision of the company officer or craft's captain.

(3) *Lubrication.* On the propulsion engines and auxiliary equipment, oil levels are checked and lubricant replenished by the crew as a matter of daily routine.

(4) *Reports.* Maintenance personnel will report the results of servicing operations to the section leader or other designated authority. Services or repairs beyond the scope of the personnel's ability, supplies, tools, or time, and those not permitted by the tactical situation are referred to unit mechanics, who make adjustments, minor repairs, and unit replacements within their scope.

c. SECOND ECHELON. (1) *Monthly and semi-annual service.* The second echelon performs 200-hour, or monthly, and 1200-hour, or semi-annual, maintenance service. These periodic preventive maintenance services should be performed continuously throughout the period so that no large number of craft will be tied up at any one time. One-twentieth of an organization's craft should receive the 200-hour monthly service every day and 1/26 should receive the 1200-hour service each week.

(2) *Work beyond echelon's scope.* The second echelon refers work beyond its scope to the third or fourth echelon, as required.

(3) *Special circumstances.* Special preventive maintenance services to meet special operating conditions may be performed by the first or second echelon, or both. These include seasonal services and maintenance of craft operating under abnormally high or low temperature or other unusual conditions.

5. Records and Reports

a. FIRST ECHELON. The commanding officer or other authorized individual operating a vessel en-

gaged in a non-tactical mission or not in convoy is required to carry aboard his vessel a WD AGO Form 55-124, Marine Craft Operator's Daily Trip Ticket and P.M. Service Record (fig. 2). This form is the commanding officer's official authorization for operating the craft. When properly filled out the form contains a record of the route, destination, load, tachometer and hour readings, and other information pertinent to the trip. In addition, this form lists items on the craft to which attention must be given daily (before-operation, during-operation, and after-operation) and weekly. While commanding officers operating vessels in convoy are not required to carry a trip ticket, they may use the form as a reminder or check-list during training for their daily and weekly maintenance activities. Instructions for performing the services scheduled for each of these items are contained in chapter 2, and in the technical manual on the specific engine or equipment.

b. SECOND ECHELON AND TECHNICAL INSPECTION. WD AGO Form 55-125, Preventive Maintenance Service and Technical Inspection Work Sheet for Marine Craft (figs. 3 and 4), is provided as a reminder and as a record of second echelon preventive maintenance services and technical inspections. Instructions for performing these services are contained in chapter 3, and in the technical manual on the specific engine or equipment.

c. DUTY ROSTER. While preventive maintenance services must be performed on a regular time cycle, only a small proportion of the equipment used by an organization can be tied up for these services at any given time. A control system is prescribed, and a record of it will be kept in WD AGO Form 6, Duty Roster, suitably adapted for this purpose.

(1) *Adapting the form.* How WD AGO Form 6 may be adapted for use as a maintenance roster is illustrated in figure 1. On the outside cover the words "DUTY ROSTER" will be lined out, and the words "MARINE CRAFT PREVENTIVE MAINTENANCE ROSTER" will be entered. The words in parenthesis "(SEE AR 345-25)" will be lined out, as will be "FOR THE MONTH OF." The first 5 columns of all left-handed pages throughout the form will not be used; they will be left blank. The heading "NATURE OF DUTY AND WHEN LAST PERFORMED" will be lined out. The heading "KITCHEN POLICE" at the top of column 6

**MARINE CRAFT
PREVENTIVE MAINTENANCE ROSTER**
~~**DUTY ROSTER**~~
OF
[Organization]
FOR THE MONTH OF [Month]

No.	MARINE CRAFT PREVENTIVE						MAINTENANCE ROSTER						JUNE 44																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1	R	R	R	W1	W2	W3	W1	W2	W3	W4	W5	W1	W2	W3	W4	W5	W1	W2	W3	W4	W5	W1	W2	W3	W4	W5	W1	W2	W3	W4	W5
2	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
3	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
4	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
5	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
6	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
7	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
8	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
9	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
10	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
11	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
12	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R

No.	Charge of Quarter and Name Initial	Make	Nomenclature	Craft No.
1	JOHNSON	SEAHAWK	Y-416-413	
2	ROGER	QUEEN	Y-612-519	
3	WILLIAMSON	COMMANDER	J-237-816	
4	AJAX	INVADER	J-166-184	
5				
6				
7				
8				
9	LAMBEAT	MARINER	J-862-979	
10				
11	JOHNSON	HEAVYWEIGHT	Y-312-473	
12				

W. D., A. G. O. Form No. 6
February 1, 1943
U. S. NAVY BUREAU OF NAVAL AIRCRAFT
#16-33043-1

Figure 1. This shows how WD AGO Form 6, Duty Roster, may be adapted for use as a marine craft preventive maintenance roster.

will be lined out, and the word "NO." entered. The word "MAKE" will be entered at the top of column 7, "NOMENCLATURE" at the top of column 8, and "CRAFT NO." at the top of column 9. The words "GUARD ROSTER" at the top of all right-hand pages will be lined out. In the space will be entered, at the left, "MARINE CRAFT PREVENTIVE MAINTENANCE ROSTER," followed by, at the right, the month and year.

(2) *Left-hand pages.* The lines on the left-hand pages will be used to list the number of items being entered, the make, nomenclature, and craft designation number of each craft operated by the organization. One line will be used for each craft if lubrication records on the craft are kept separately. However, if lubrication records are not kept separately, a record of lubrication activities will be entered in the roster. In such cases two lines of the page will be used for each craft.

(3) *Right-hand pages.* The right-hand pages contain 32 columns. The first 31 columns represent the 31 days of the month. The last column is used for a numerical listing of items.

(4) *Making entries.* (a) To start the roster, enter on the left-hand pages the make, nomenclature, and craft designation number of each craft operated by the organization. On right-hand pages, and on the line with each craft, leave blank spaces for the number of days remaining until the craft is scheduled to receive its next weekly, monthly, or semi-annual preventive maintenance service.

(b) In the column representing the day of the month on which maintenance inspection takes place, enter the letter *W*, for weekly, *M*, for monthly or 200 hours, or *S*, for semi-annually or 1200 hours. If *W* is used, a small numeral should be written next to it to indicate the number of weeks that have passed since the preceding month-

ly service. If *M* is used, a small numeral should be written next to it indicating the number of months that have passed since the last semi-annual service. Thus, *W1* would indicate the first weekly service since the last monthly service took place; *M4* would indicate the fourth monthly service since the last semi-annual service took place.

(c) After each inspection and service, the date and nature of the next scheduled inspection and service will be indicated, as follows: *W1, W2, W3, M1, W1, W2, W3, M2, W1, W2, W3, M3, W1, W2, W3, M4, W1, W2, W3, M5, W1, W2, W3, S.*

(d) Additional symbols to be used where they apply follow:

P—Deadlined for lack of parts.

A—Deadlined because of accident.

R—Deadlined in repair shop.

(e) When conditions make it impossible to perform maintenance operations on schedule, the entry in the roster will be circled. This circle will indicate that the craft was serviced out of normal order.

(5) *Scheduling.* Each day, or whenever convenient, an officer detailed for the purpose will determine which craft are due for weekly, monthly, or semi-annual services.

(6) *Checking.* When the weekly service is under way, a check should be made to determine that the daily services are being performed properly. When the monthly service is being performed, an individual representing the operating personnel should be present to perform weekly service and to supply necessary information to the second echelon.

(7) *Regularity.* Every effort should be made to assure that each craft undergoes preventive maintenance at the scheduled time. Circled entries in the roster, indicating off-scheduled servicing, will be kept to a minimum.

FIRST ECHELON PREVENTIVE MAINTENANCE OF MARINE CRAFT

Section I. General

6. Role of Operating Personnel

a. DETECTING TROUBLE EARLY. The operating personnel of a vessel is the most important single factor in effective preventive maintenance. Crew members are responsible for keeping their craft in good, sound operating condition by taking precautionary measures at regular intervals. Each crew member is required to perform certain daily maintenance duties, and the faithful performance of these duties will prolong the life of the craft and avoid the necessity for major repairs and overhaul by higher echelons.

b. DUTIES AND RESPONSIBILITIES. Preventive maintenance by operating personnel involves the following duties and responsibilities:

(1) Inspection and servicing of craft in accordance with the list of maintenance services prescribed on WD AGO Form 55-124.

(2) Repair of defects which crew members are authorized to repair, capable of repairing, and equipped to repair.

(3) Reporting the existence of defects which cannot be repaired by operating personnel.

(4) Avoidance of operating practices which may result in abusive handling of vessel and equipment.

7. Inspection and Service

a. LIST OF ITEMS. The items to be inspected and serviced daily and weekly by operating personnel are listed on WD AGO Form No. 55-124. The service items apply to all craft operated by the Transportation Corps. Procedures involved in these service items are described in section II of this chapter.

b. FAMILIARITY WITH ITEMS. Operating personnel of all craft are required to become thoroughly familiar with the service items listed and with the procedures to be followed in doing the work indicated, so that the services will be performed automatically at the proper times, either before, during, or after operation. Personnel undergoing

training will use WD AGO Form 55-124 as a check list.

c. RELATED ITEMS. The general inspection and service of each piece of equipment or part applies also to any supporting part or connection. In addition, it usually includes a check to see whether the part is in good condition, correctly assembled, secure, or excessively worn.

(1) Inspection for "good condition" usually is an external visual inspection to determine if the unit is damaged beyond safe or serviceable limits, or if it is in such a condition that damage will result when it is operated. "Good condition" means not rusted, corroded, bent, twisted, chafed, burned, broken, cracked, bare, frayed, dented, collapsed, torn, cut, or inadequately lubricated.

(2) Inspection of a unit to see that it is "correctly assembled" is usually an external, visual inspection to determine if it is in its normal position in relation to other units.

(3) Inspection of a unit to determine if it is "secure" is usually an external inspection, a hand-feel, or a wrench-check for looseness. The inspection should include any brackets, lock washers, lock nuts, locking wires, or cotter pins used in an assembly.

(4) "Excessively worn" means worn close to or beyond serviceable limits, and likely to result in a failure if not replaced before the next scheduled inspection.

8. Scheduled Preventive Maintenance

a. BEFORE-OPERATION SERVICES. These services are performed to determine if conditions have changed since the last after-operation service. Many things can happen to a vessel between service inspections. Sabotage may be attempted, booby traps may be installed, another vessel may run into it, an object may fall on it, moisture may damage the electrical system, and oil, fuel, or water may leak out. Therefore, at least a quick check is necessary before any craft is put into op-

eration. The before-operation service should never be entirely omitted, even in extreme tactical situations.

b. DURING-OPERATION SERVICES. The during-operation service consists of detecting improper performance. It is important to be alert for unusual noises, smoke, steam, or odors, to detect unsatisfactory performance of engine or equipment, and to take corrective steps before the deficiencies develop to the point of actual breakdown, fire, or accident.

c. AFTER-OPERATION SERVICES. After-operation services prepare the craft to operate again at a moment's notice. This service is particularly important, because it is at this time that crew members inspect the craft thoroughly to detect any deficiencies that may have developed and correct those coming within their authority. Results of this servicing should be reported to the section leader, or other designated authority. If this service is performed thoroughly, the craft should be ready to operate immediately when required. The after-operation services should never be omitted entirely even in extreme tactical situations.

d. WEEKLY SERVICE. Weekly service is designed to re-inforce daily maintenance. It consists of the after-operation services plus additional attention to certain items, including a general tightening, cleaning, and lubrication if required. The section leader, chief engineer, and the company officer should carefully supervise and inspect the weekly maintenance work performed by the crew.

Section II. Procedures for Scheduled Preventive Maintenance Services

9. General

The before, during, and after-operation preventive maintenance services to be performed are listed on WD AGO Form 124, illustrated in Figure 2. A description of what is involved in each item of service is given in the succeeding paragraphs of this section.

10. Before-operation Service

Before-operation service consists of inspecting the items listed below according to the procedures prescribed, and of correcting any deficiencies or reporting them to designated authorities. Upon completion of the service, results should be reported promptly to the organization commander

or other authorized individual. This service should never be entirely omitted even in extreme tactical situations.

a. ITEM 1, TAMPERING AND DAMAGE. Inspect for any injury to craft, special equipment, or armament. Inspect for any damage that may have resulted from falling debris, shell fire, sabotage, collision, or booby traps. Open engine compartment doors, and look for signs of tampering or sabotage such as loosened or damaged accessories or drive belts. Inspect bilge for presence of gasoline, oil, or excessive water due to leakage. Dry spark plugs, distributor, or magnetos and wiring, if they are wet. This will facilitate starting. Inspect outside of hull for evidence of damage.

b. ITEM 2, FIRE EXTINGUISHERS. Inspect for tight mountings, full charge, corroded nozzles, and closed valves. Pay particular attention to extinguisher lines and nozzles in the engine compartment, checking for damage and correct aiming.

c. ITEM 3, FUEL, OIL, WATER. Check the amount of fuel in the tanks, noting any indications of leaks or tampering. Add fuel if necessary, and check spare fuel cans. Check oil level, and add oil if necessary. Check level and condition of coolant. During period when antifreeze is used, make hydrometer test of coolant. Add anti-freeze to water if required.

Note: Any appreciable change in levels since the last after-operation service should be investigated and reported to designated authority.

d. ITEM 4, ACCESSORIES AND DRIVES. Inspect all accessories, such as carburetors, generators, regulators, supercharger, fuel-injection pump, starters, fans, shrouds, and water pumps for loose or damaged connections or mountings.

e. ITEM 5, START CONTROL. Start the engine and note action of the starter mechanism, particularly whether the starter has adequate cranking speed and engages and disengages properly without unusual noise when starting control is operated. Inspect for proper oil circulation. Set throttle so that engine will run at normal warm-up speed (idling). During the warm-up period, proceed with the following before-operation services. *Caution:* If oil pressure gauge does not indicate properly within 30 seconds, the engine should be stopped and the trouble corrected or reported to proper authority.

f. ITEM 6, INSTRUMENTS. (1) *Oil pressure gauge or light indicator.* Inspect the gauge to see

W.D., A.G.O. FORM NO. 55-124 9 August 1944		MARINE CRAFT OPERATOR'S DAILY TRIP TICKET AND P.M. SERVICE RECORD		DESIGNATION NO. OF CRAFT	DATE
				NAME OF OPERATOR	
REPORT TO		ORGANIZATION		TIME OUT	TIME IN
DEPARTMENT OR ADDRESS			KIND OF WORK (or route)		
REQUESTED BY (Organization or Individual)			DISPATCHER'S SIGNATURE		
FUEL ADDED (gals.)		OIL ADDED (qts.)		ENGINE LOG RECORD	
		"PORT"		"STA' BOARD"	
		TACHOMETER	HOUR METER	TACHOMETER	HOUR METER
I have performed the "Preventive Maintenance Services" on this form and recorded all deficiencies and any accident. (Operator's Signature)		IN		IN	
		OUT		OUT	
I have noted all entries on this form and taken the necessary action. (Dispatcher's, etc., Signature)		TOTAL		TOTAL	
TRIP OR LOAD RECORD		PASSENGERS OR WEIGHT		TACHOMETER	
FROM					
TO					
TO					
TO					
TO					
TO					
TO					
TO					
TO					
RELEASED AT (Tachometer-Hour Meter)		RELEASED AT (Date)		RELEASED AT (Hour)	
DAILY PREVENTIVE MAINTENANCE SERVICES					
Perform these services according to the instructions in TM55-320 or craft manual.					
BEFORE OPERATION SERVICES			DURING OPERATION SERVICE		
1. TAMPERING AND DAMAGE	9. HORN AND WS WIPERS	15. ENGINE OPERATION	22. ACCESSORIES		
2. FIRE EXTINGUISHERS	10. GLASS AND TARPS	16. CONTROLS AND DRIVE	23. LEAKS-GENERAL		
3. FUEL, OIL, WATER	11. LAMPS	17. PROPELLER AND RUDDER	24. BILGE PUMP		
4. ACCESSORIES AND DRIVES	12. TOWING CONNECTIONS	18. FUEL, OIL AND WATER	25. TOWING CONNECTIONS		
5. START CONTROL	13. TOOLS, SPARE PARTS, AND EQUIPMENT	19. INSTRUMENTS	26. HULL, LOAD, TARPS		
6. INSTRUMENTS	14. AUXILIARY EQUIPMENT	20. TEMPERATURES AND PRES-SURES	27. APPEARANCE AND GLASS		
7. STEERING LINKAGE		21. STEERING GEAR, LINKAGE	28. AUXILIARY EQUIPMENT		
8. LEAKS-GENERAL					
AFTER OPERATION SERVICE					
29. ENGINE-GENERAL	*42. BILGE PUMP	*48. AUXILIARY EQUIPMENT			
30. FUEL, OIL, WATER	43. FIRE EXTINGUISHERS	*49. HULL, LOAD, TARPS			
31. INSTRUMENTS	44. HORN AND WS WIPERS	*50. LUBRICATE AS NEEDED			
*32. BATTERIES	45. GLASS AND LAMPS	51. FIRST AID KIT AND LIFE PRESERVERS			
*33. ACCESSORIES AND BELTS	46. TOWING CONNECTIONS				
*34. ELECTRICAL WIRING	47. TOOLS, SPARE PARTS AND EQUIP.				
35. AIRCLEANERS, BREATHER CAPS	THOSE ITEMS MARKED BY AN ASTERISK () REQUIRE ADDITIONAL WEEKLY SERVICES.				
*36. FILTERS, STRAINERS (Oil, Fuel, Water)	RECORD ANY ACCIDENT AND ALL DEFICIENCIES, INDICATING IF CORRECTED; IF NONE, STATE NONE (For additional space use reverse side)				
37. ENGINE CONTROLS					
38. PROPELLER AND RUDDER					
*39. GEAR OIL LEVELS					
*40. AIR COMPRESSOR (Tank)					
41. LEAKS-GENERAL					

Figure 2. WD AGO Form 55-124, Marine Craft Operator's Daily Trip Ticket and P.M. Service Record.

whether it indicates properly, and check the light indicator to see whether it fails to go out. If these instruments do not indicate properly, stop the engine immediately, investigate the cause, and report it to the proper authority.

(2) *Ammeter or light indicator.* The ammeter should show a high charging rate for the first few minutes after starting until the generator restores to the battery the current used in starting. After this period, the ammeter should register a zero or slight positive charge with lights and accessories turned off and the engine operating at a fast idle. Any unusual drop or rise in reading should be investigated. A high charge reading for an extended period may indicate a dangerously low battery or faulty generator regulator. A light indicator should go out when the engine is running at fast idle with lights turned off.

(3) *Tachometer.* Observe whether tachometer is operating properly and indicating the approximate engine revolutions per minute. If there is a revolution counter, it should register the accumulating revolutions.

(4) *Fuel gauge.* Observe whether gauge is operating properly. Normally, fuel tanks should have been filled after operation, and the gauge should register "FULL."

(5) *Air pressure gauge.* During the warm-up period, operate the engine at idling speed and observe whether the air pressure builds up at a normal rate to the specified maximum limits, and whether the governor then cuts off to stop compressing action. With the engine at idling speed, bleed the air pressure down by repeated release application, and observe whether the governor cuts in the compressor within the specified limits. Again bleed down the air pressure and observe whether the low pressure indicator signals properly at the specified air pressure. Build up the air pressure again and observe whether the indicator stops as pressure is built up above the danger point.

(6) *Voltmeter.* Note whether voltmeter is operating properly. It should register at least the nominal battery voltage usually indicated by a red line on the face of the instrument.

(7) *Temperature gauge.* Engine temperature should increase gradually during the warm-up period. Extremely low temperature after a reasonable warm-up period may indicate existing troubles that should be investigated and corrected. Extremely high temperatures may indicate defect in the cooling system.

g. ITEM 7, STEERING LINKAGE. Inspect gear and linkage to see that they are in condition for safe operation. Pay particular attention to the steering arms and steering linkage, looking for loose or bent parts.

h. ITEM 8, LEAKS—GENERAL. Inspect in the engine compartment and interior of the hull for indications of leaks. Observe whether oil is leaking from crankcase, oil tanks, oil coolers, filters, or lines. Inspect the cooling system for leaks, paying particular attention to connecting hose. *Caution:* As a precaution against fire or explosion, before starting the engine, open the ventilators or hatches to be sure that the hull compartments, particularly the engine compartment, are clear of fuel drippings and gas fumes. On craft equipped with exhaust blowers, operate blowers at least five minutes before starting engines.

i. ITEM 9, HORN AND WINDSHIELD WIPERS. Press the horn or siren button (unless tactical situation prohibits) to see that the signal is normal. Inspect the windshield wipers for missing or damaged blades or arms, and note whether the blades contact the glass properly. Start the windshield wipers, and see that they operate normally through their full stroke.

j. ITEM 10, GLASS AND TARPS. Inspect glass, frames, and brackets for damage; also clean the windshield and door glass. Inspect tarpaulins for rips or damage and, if not in use, observe whether they are properly stowed and secured.

k. ITEM 11, LAMPS. Within the limits permitted by the tactical situation, check operation of all switches and see that all lamps (lights) operate properly. See that the lamps are secure, and that lenses are clean and not broken.

l. ITEM 12, TOWING CONNECTIONS. Be sure mounting and locking devices are secure; report any damage or deficiency that may have occurred. Inspect all towing hitches and units to see that they are in proper condition for safe operation.

m. ITEM 13, TOOLS, SPARE PARTS, AND EQUIPMENT. See that tools, spare parts, and equipment belonging to the craft are present, clean, serviceable, and properly mounted or stowed.

n. ITEM 14, AUXILIARY EQUIPMENT. Inspect condition of auxiliary equipment and units, including bilge pumps, to see that they are in proper condition for safe operation. Be sure all mountings, drives, locking devices, and accessories are secure. Report any damage or deficiency.

11. During-operation Service

During-operation service consists of observing the items listed below, and noting minor deficiencies to be corrected and reported at the earliest opportunity, usually the next scheduled halt. The vessel should be halted if serious trouble develops. Operating personnel should listen for signs of trouble, such as rattles, knocks, squeals, or hums. They should watch for steam or smoke coming from any part of the vessel, and should be on the alert to detect unusual odors, such as may come from an overheated generator, overheated clutch, boiling coolant, overheated lubricants, fuel vapors from leaks, exhaust gas, or other sources of trouble. Action of clutch should be observed carefully every time it is operated. Instruments should be watched carefully for indications of improper functioning of important parts.

a. ITEM 15, ENGINE OPERATION. Be on the alert for deficiencies in engine performance, such as lack of usual power, misfiring, unusual noise or stalling, indications of engine overheating, unusual exhaust smoke or temperatures, and improper lubricating oil pressure or temperature.

b. ITEM 16, CONTROLS AND DRIVE. Notice whether engine responds to the controls satisfactorily, and see that the controls are in proper adjustment. See that the clutch does not grab, chatter, or squeal during engagement, or slip when fully engaged. Clutch lever must have satisfactory free travel, as specified in the appropriate technical manual, before it begins to disengage clutch. Otherwise, clutch may slip when under load. Too much free travel, however, may keep the clutch from disengaging fully, thus causing gear teeth to clash and be damaged in operation. Gears and clutch must engage smoothly, operate quietly, and not disengage during operation. Jumping out of gear may indicate faulty adjustment or worn parts. On multiple engine installations, all transmissions should be synchronized to operate simultaneously. Inspect all drives and gear cases for overheating or excessive oil leaks.

c. ITEM 17, PROPELLER AND RUDDER. Listen for any unusual noise from shafts and supporting bearings. Inspect for looseness, damage, oil and water leaks and foreign material. Check particularly for excessive leakage from stuffing boxes. Also check level and condition of lubricant; renew if necessary.

d. ITEM 18, FUEL, OIL, AND WATER. Check circulation of fresh and salt water. At each halt,

check the fuel supply. (When refueling, use safety precautions for grounding static electricity, and allow space for expansion in filler neck. Filler cap vents must be open, pressure cap valves must be replaced securely.) Check the crankcase oil level or lube tank and, if necessary, add oil to proper level. Remove expansion water tank filler cap, being careful of steam, especially if a pressure cap is used. Check coolant to see that it is at proper level, and replenish as necessary. Do not fill to overflowing, but leave sufficient space for expansion.

e. ITEM 19, INSTRUMENTS. Observe the readings of all instruments frequently during operation to see whether they are indicating properly.

(1) *Temperature gauge.* See that the gauge reads in normal range. Excessive engine heat may indicate trouble and should be investigated immediately.

(2) *Oil-pressure gauge.* In case of any unusual drop or no oil pressure, stop the engine immediately, and report trouble to qualified personnel aboard, for correction. Lack of oil pressure may indicate insufficient oil, leaks, loose bearings, or a defective oil pump, and may result in premature wear, or may damage the engine to the extent of failure. Gauge may be defective.

(3) *Viscometer.* See that indicator remains in the normal range section of the dial with engine at normal operating temperature. Report any abnormal reading.

(4) *Ammeter.* During operation, the ammeter must indicate a zero or a positive reading with all lights and accessories turned off. A discharge reading may indicate a faulty generator or regulator. When a signal light is used instead of an ammeter, the light should be off when the engine is operated at or above a fast idle.

(5) *Tachometer.* See that tachometer indicates the engine speed and accumulating revolutions correctly at all times when the engine is running. The engine speed should not be allowed to exceed that specified on the caution plate. On multiple-engine installations, all tachometers must register approximately the same revolutions per minute. This indicates that the engine controls are synchronized properly.

(6) *Air-pressure gauge.* See that gauge indicates no more nor less than the specified governed air pressure.

(7) *Fuel gauge.* See that the gauge continues

to indicate the approximate amount of fuel in the tank.

(8) *Hour-Meter*. Hour-meter must indicate and register the total amount of accumulated engine-running-hours.

(9) *Voltmeter*. Inspect the voltmeter to see whether it registers at least the nominal battery rating. This is usually indicated by a red line on the face of the instrument.

f. ITEM 20, TEMPERATURES AND PRESSURES. Check and observe lube oil pressure and temperature, and circulating water temperature for proper heat range. Check exhaust temperature and cylinder pressure for equalization. Inspect fuel pumps and injection system. See that air pressure is maintained throughout the operation. Deficiencies will be corrected, or reported to proper authority. *Caution*: If low oil pressure is indicated, stop the engine, correct the situation, or report it to the proper authority.

g. ITEM 21, STEERING GEAR, LINKAGE. Examine the steering control mechanism, arms, and linkage for damage and looseness, and investigate any irregularities noted during operation. See that there is no excessive pulling from either side or excessive wandering of the craft. This may be caused by excessive play in the steering mechanism, excessive wear in the steering linkage, loose parts, or maladjustment.

h. ITEM 22, ACCESSORIES. See to it that water pumps, generator, supercharger, fuel-injection pump, carburetor, regulator, starter, fans, shrouds, etc., are secure and that all their drives and drive belts are in correct adjustment and not damaged. See that they are functioning properly.

i. ITEM 23, LEAKS—GENERAL. Observe whether oil is leaking from crankcase, oil tanks, oil coolers, filters, or lines. Check the cooling system for leaks. Inspect the fuel system and the air system for leaks, paying particular attention to valves, couplings, fittings and connections.

j. ITEM 24, BILGE PUMP. Inspect condition, lubrication, and working operation of bilge pump, paying particular attention to screens, strainers, stuffing boxes, connections and drives.

k. ITEM 25, TOWING CONNECTIONS. Inspect all towing connections in use to see that they are properly fastened and securely locked.

l. ITEM 26, HULL, LOAD, TARPS. Inspect craft hull and loads for shifting and condition; also check the tarpaulins to see that they are properly secured

and not damaged, and when not in use, properly stowed.

m. ITEM 27, APPEARANCE AND GLASS. Inspect windshield, door and window glasses, light lenses, reflectors and blackout curtains, and inspect entire craft for cleanliness and damage.

n. ITEM 28, AUXILIARY EQUIPMENT. Inspect condition, lubrication and working operation of auxiliary pumps, generators, winches, motors, compressors, refrigerating units, ventilating units and accessories. Inspect wiring and controls. Notice if any unit indicates that it may be operating improperly. If there is trouble, detect the source of it and either correct it or report it to the proper authority.

12. After-operation Service

After-operation service consists of inspecting the items listed below and correcting any deficiencies or reporting them to designated authorities. This will be performed immediately after each use of the craft. Items marked with an asterisk (*) will receive certain additional attention at the time weekly service is performed (par. 8*d*). Upon completion of these services, results will be reported promptly to the commanding officer or other authorized individual. When performing after-operation services, operating personnel will take into consideration any irregularities in performance noticed in the during-operation service. Units requiring inspection or service while at operating temperatures should be inspected as soon as possible after operations cease. The after-operation service should never be omitted entirely even in extreme tactical situations.

a. ITEM 29, ENGINE—GENERAL. (1) See that the engine idles satisfactorily. Accelerate and decelerate the engine, and note any tendency to miss or backfire, or any unusual engine noise or vibration that might indicate worn parts, loose mountings, incorrect fuel mixture, or faulty ignition. Correct or report any unsatisfactory engine operating characteristics noted during operation.

(2) Clean exterior of the engine and dry thoroughly, taking care to keep cleaning solvent away from electrical wiring and equipment. Hot water and soap not harmful to insulation should be used when available. *Caution*: Do not use waste or linty rags when cleaning a diesel engine.

(3) Clean out the engine room.

b. ITEM 30, FUEL, OIL, WATER. Check coolant

level and replenish as necessary, taking care to leave sufficient space for expansion. If a large amount of coolant is required, check the quality of the antifreeze. Fill fuel tanks, observing safety precautions for grounding static electricity, and bring engine oil to proper level. Refill spare fuel, oil, and water cans. If an unusual amount of oil or coolant is required for engine, check for leaks and report the condition.

Note: In cold weather have a hydrometer test made of the coolant.

c. ITEM 31, INSTRUMENTS. Be sure all instruments are securely mounted, properly connected, and undamaged.

d. ITEM 32, * BATTERIES. Inspect the battery to see that it is clean, secure, and not leaking. Cables and vent caps should be cleaned and fastened. *Weekly:* Wipe off dirt from top of battery. If terminal connections or posts are corroded, clean them thoroughly and apply a thin coating of grease. Tighten terminal bolts if they are loose. Remove vent caps and check level of electrolyte. Add water if required, taking precautions so that battery will not be damaged during freezing temperatures. Battery should be secure, not bulging, cracked or leaking electrolyte. The battery carrier should be secure, clean, free of rust, and well painted. If mountings are loose, tighten them cautiously so as not to damage the battery case. Report any defects to designated authority.

e. ITEM 33, * ACCESSORIES AND BELTS. Inspect all accessories, such as pumps, starters, regulators, generators, etc., for loose connections, mountings, and lubrication. Inspect adjustment of accessory drive belts. Belts should deflect the amount specified in craft manual. *Weekly:* Tighten or adjust any loose connections, linkage or mountings on accessories. Examine all belts for fraying, wear, cracking or presence of oil. Loose belts may cause improper operation of accessories and may become damaged. Tight adjustment may cause damage to both accessories and belts. Also check any accessory drive shafts, couplings, or universal joints to see that they are secure and not leaking or damaged.

f. ITEM 34, * ELECTRICAL WIRING. Inspect all electrical wiring to see that it is securely connected, clean, and not damaged. *Weekly:* Inspect all accessible wiring, fuse terminal blocks and connections to see that they are securely connected and supported, that the insulation is not cracked or chafed, and that its conduits and shielding are in good condition and secure.

g. ITEM 35, * AIR CLEANERS, BREATHER CAPS. Check to see that the oil in the air cleaner is at the correct level and not excessively dirty. It is not usually necessary to remove the air cleaner to make this inspection. If the oil in the cleaner is excessively dirty, clean and refill with fresh oil. In order to keep the abrasive dirt out of the engine, air cleaners and breather caps must be kept clean and properly serviced at all times. *Weekly:* Remove and disassemble the air cleaners. Clean the bodies and elements in solvent. Fill the reservoirs to the correct level with clean engine oil. Apply engine oil to the elements and allow the excess to drain. When reassembling the cleaners, make sure that all gaskets are in good condition and in place. Reinstall the air cleaners, giving special attention to mountings to see that cleaners are pressed firmly in place against the air-horn seals, correctly aligned, and secure. Remove all breather caps and crank-case filter cleaning elements. Wash them thoroughly in solvent, dip in engine oil, drain off the excess, and reinstall. If breathers are of the oil-bath type, clean and service them in the same manner as for the oil-bath air cleaner above.

h. ITEM 36, * FILTERS, STRAINERS (OIL, FUEL, WATER). (1) *Fuel filter.* On Cuno-type filters turn the handle one complete turn. Check all fuel filters for leaks. *Weekly:* On craft where the fuel tank is above the filter, close the shut-off valve in the fuel line. Remove the drain plug to allow water and sediment to drain out of the filter bowl. Then replace drain plug, tighten it securely, reopen shut-off valve in fuel line, and note whether fuel is leaking from drain plug. Replace fuel element in accordance with craft manual.

(2) *Oil filter.* Do not wash oil filter bags for re-use. Clean metal type filters with solvent or diesel fuel. Replace oil filters in accordance with Lubrication Order or craft manual.

(3) *Water strainer.* Inspect and clean circulating water strainers, screens and bypasses, noting condition of the mesh; if defective, replace.

i. ITEM 37, ENGINE CONTROLS. Check for worn, disconnected linkage; report any unsatisfactory engine control linkage noted during operation.

j. ITEM 38, PROPELLER AND RUDDER. Inspect these items for loose connections, leaks of lubricant, water or oil, and damage, paying particular attention to loose mountings, blocked vents, and lube level.

k. ITEM 39, * GEAR OIL LEVELS. Inspect drives, transfer units and gear cases for lubricant level and leaks. Refer to craft manual for correct lubricant level and type. *Weekly*: Observe condition of lubricant, replace if visual inspection shows need. Refer to craft manual for correct lubricant level, type and replacement period. Correct any lube leaks.

l. ITEM 40, * AIR COMPRESSOR (TANK). Examine the air compressor to see that it is in good condition, properly alined with its drive pulleys, and secure. Open air tank pet cocks and drain water (condensation). Correct any deficiencies noticed during operation. *Weekly*: Lubricate in accordance with Lubrication Order. Clean governor air strainer, adjust unloader valve clearance, tighten or adjust all drives, drive belts, pulleys, hubs and engine mounts. Tighten loose tank mountings and air line connections. Clean air line of any grease and oil.

m. ITEM 41, LEAKS—GENERAL. Inspect engine compartment and engine for indications of fuel, oil, air, or water leaks. Trace all leaks to their source, and correct or report them.

n. ITEM 42, * BILGE PUMP. Inspect loose pump connections, lubricant, water leaks and damage, paying particular attention to mounting and drive. *Weekly*: Clean and service pump assembly in accordance with Lubrication Order. Check valves, drive, strainers and lubricant for proper operating conditions.

o. ITEM 43, FIRE EXTINGUISHERS. See that the entire system is in good condition and securely mounted. If the red blow-off seal on the valve head of the fire extinguisher is blown, or if the extinguisher has been used, report it for refill or replacement. Be sure the nozzles are cleaned of any obstructions, dirt or corrosion.

p. ITEM 44, HORN AND WINDSHIELD WIPERS. See that the horn is mounted and properly connected. See that the arms and blades of windshield wipers are in good condition, and that the wipers operate properly.

q. ITEM 45, GLASS AND LAMPS. Clean windshield and other glass to be sure it is securely mounted and undamaged. Observe whether the lights operate properly with the switches at all "on" positions, and go out when switched "off." Inspect all lenses for dirt or damage; clean if

necessary. Be sure that all lamps are off after they have been inspected.

r. ITEM 46, TOWING CONNECTIONS. Inspect towing hooks, capstans, safety chains, and cables for looseness or damage.

s. ITEM 47, TOOLS, SPARE PARTS, AND EQUIPMENT. Check against craft stowage lists to see that all tools, spare parts, and equipment assigned to the craft are aboard and properly stowed or mounted. Clean all tools and equipment of rust, mud, or dirt, and see that they are in good condition. Report missing or unserviceable items to proper authority.

t. ITEM 48, * AUXILIARY EQUIPMENT. Inspect auxiliary equipment, including all pumps, for lubricant, adjustment, and alinement. *Weekly*: Clean and service auxiliary equipment. Refer to craft manual for correct lubricant levels, adjustment, and servicing instructions.

u. ITEM 49, * HULL, LOADS, TARPS. Inspect the hull and cargo carefully for leaks, damage, or loose parts. The load should be evenly distributed and secure. Tarpaulin should cover the load to protect it against the elements. All ropes should be lashed securely to hooks or rings. Check tarpaulin and curtains for rips or holes, missing or worn grommets, and ropes.

Note: Decks should be swabbed daily and bulkheads and bilges kept clean at all times. If there are any odors of gas, the source should be located and the trouble corrected.

v. ITEM 50, * LUBRICATE AS NEEDED. Items such as shackles, steering linkage, hinges, latches, auxiliary equipment, accessories and other points that are lubricated by the operating personnel should be lubricated if inspection indicates it is necessary. *Weekly*: Lubricate in accordance with the Lubrication Order for the craft concerned. Lubricate all points shown on the Lubrication Order requiring weekly lubrication, also all other points where experience and inspection indicate a need for lubrication. The need for more frequent lubrication than is provided by the regular lubrication schedule is usually due to abnormally hot or wet operating conditions.

w. ITEM 51, FIRST-AID KIT AND LIFE PRESERVERS. Check the first-aid kit for condition and supply of necessary items for replacement. Observe that all life preservers are properly mounted in position. Check for shortage and worn or damaged equipment, and replace it.

SECOND ECHELON PREVENTIVE MAINTENANCE AND TECHNICAL INSPECTION OF MARINE CRAFT

13. General

a. PREVENTIVE MAINTENANCE SERVICES. Regularly scheduled maintenance inspections and services are a preventive maintenance function, and are the responsibility of the commanders of operating organizations. An efficient control system is an essential aid in determining when vessels are due for periodic maintenance services, either because of time elapsed or of running time accumulated. These preventive maintenance services include:

(1) Maintenance services by company, detachment, or similar units, for craft and auxiliary equipment at monthly (200-hour) intervals.

(2) Maintenance services by regiment, battalion, separate company or detachment, for craft and auxiliary equipment at semiannual (1200-hour) intervals.

b. INTERVALS. The frequencies of preventive maintenance services outlined in this manual are considered to be the minimum requirement for normal operation of craft. Under unusual operating conditions it may be necessary to perform the maintenance services more frequently.

c. FIRST ECHELON PARTICIPATION. (1) Operating personnel should accompany their craft when possible and assist the mechanics while periodic second echelon preventive maintenance services are performed.

(2) Ordinarily the craft should be presented for a scheduled preventive maintenance service in a reasonably clean condition.

d. TECHNICAL INSPECTIONS. These inspections are performed by technically qualified personnel, under direct supervision of technically qualified officers. Whenever a craft goes to third or higher echelon maintenance shop for repair, it will receive a technical inspection to insure that all defects have been corrected before it is returned to the using organization. Except in the theater of operations, technical inspections will be made whenever accountability is transferred, to determine craft condition. Technical inspections are made for the following purposes:

(1) To determine whether a craft should be continued in service or withdrawn for overhaul or reclamation of component parts.

(2) To determine extent of damage and estimated cost of repair in Report of Survey, and other similar proceedings.

(3) To discover causes of difficulties encountered in operation of craft, so that efficiency may be improved.

14. Preventive Maintenance Services and Technical Inspection Work Sheets

For purposes of establishing uniform procedure for preventive maintenance services and technical inspections, a Work Sheet has been devised and adopted as WD AGO Form 55-125, Preventive Maintenance Service and Technical Inspection Work Sheet for Marine Craft. The front and reverse sides of this form are illustrated in figures 3 and 4, respectively. The general procedures described in succeeding paragraphs are to be applied to this form in conducting maintenance services and technical inspections. The specific procedures explain in detail the manner in which each item listed on the form is to be inspected and serviced. Due to their similarity, the procedures for the 1200-hour (semiannual) maintenance service and for the technical inspection have been listed on the same form. Ordinarily, however, the technical inspection is performed by third or higher echelon, while the 1200-hour service is performed by second echelon. If instructions other than those contained in either the general or the specific procedures are required for the correct performance of a preventive maintenance service or for the correction of a deficiency, the craft engineer or the craft manual should be consulted.

15. General Procedures

a. BASIC INSTRUCTIONS. These general procedures are basic instructions which are to be followed when performing the services on the craft

W. D., A. G. O. FORM NO. 55-125 9 August 1944								DESIGNATION NUMBER		DATE			
PREVENTIVE MAINTENANCE SERVICE AND TECHNICAL INSPECTION WORK SHEET FOR MARINE CRAFT								LENGTH AND TYPE					
								ENGINE MFGR.					
1200 HOUR (Semi-annual) Maintenance or Technical Inspection. 200 HOUR (Monthly) Maintenance.													
TYPE	CYCLE	MODEL	CYLINDERS	BORE	STROKE	H.P.	R.P.M.	START	DRIVE	SUPERCHARGER			
SEE TM 55-320 AND CRAFT MAINTENANCE MANUAL FOR DETAILED INSTRUCTIONS.													
Legend for Marking: ✓-Satisfactory, X-Adjustment Required, XX-Repair or Replacement Required, O-Defect Corrected. Symbols: — Inspect and correct; C-Clean; T-Tighten; A-Adjust; L-Lubricate; D-Drain; S-Serve.													
ENGINE RUNNING	1200 HOUR	200 HOUR	1. AIR PRESSURE (Build-Up) (Governor Cut-Off) (Low Pressure Indicator)					1200 HOUR	200 HOUR	36. COIL AND WIRING (High and Low Voltage) (Supports)			
	—	—	2. INSTRUMENTS AND GAGES (Oil Pressure and Temperature and Hour Meter) (Ammeter and Voltmeter) (Tachometer and Revolution Counter) (Engine Temperature) (Fuel Oil Pressure) (Fuel)					<u>C</u>	<u>C</u>	37. MAGNETOS (Points)			
	—	—	3. WINDSHIELD, WINDSHIELD WIPER, HORN					<u>A</u>	<u>A</u>	38. DISTRIBUTOR (Cap) (Rotor) (Points) (Shaft) (Advance Units)			
	—	—	4. CLUTCH DRIVE (Free Travel) (Linkage)					<u>AL</u>	<u>AL</u>	39. BATTERY (Cables) (Hold-Downs) (Gravity and Voltage)			
	—	—	5. GEAR DRIVE (Lever Action) (Declutching) (Vibration) (Noise) (Control Synchronization)					<u>CS</u>	<u>CS</u>	40. AIR COMPRESSOR (Unloader Valve) (Governor) (Lines) (Tank)			
	—	—	6. STEERING (Gear) (Control) (Linkage)					<u>CLA</u>	<u>CLA</u>	41. GEAR OIL LEVELS			
	—	—	7. DIRECT DRIVE REVERSE GEAR MECHANISM					<u>CT</u>	<u>CT</u>	42. STARTING MOTOR (Air) (Electric) (Controls)			
	—	—	8. AIR CONTROL (Controlair) (Actuator) (Pneudyne) (Valves)					<u>TA</u>	<u>TA</u>	43. TIMING (Diesel) (Gasoline)			
	—	—	9. SUPERCHARGER (Operation) (Lube) (Vibration)					<u>T</u>	<u>T</u>	44. BILGE PUMPS (Drives) (Valves) (Control) (Lines) (Strainers)			
	—	—	10. ENGINE (Idle) (Acceleration) (Power) (Noise) (Smoke) (Governed Speed)					<u>T</u>	<u>T</u>	45. PROPELLER (Shafts) (Seals) (Joints) (Bearings) (Stuffing Box)			
	—	—	11. SAFETY DEVICES (Overspeed Safety Trip) (Low Oil Safety Shutdown)					<u>T</u>	<u>T</u>	46. RUDDER (Shafts) (Arms) (Cables) (Rod) (Brackets) (Controls)			
	ENGINE STOPPED	—	—	12. LEAKS (Fuel Oil) (Engine Oil) (Water) (Air)					<u>TA</u>	<u>TA</u>	47. PUMPS (Drives) (Valves) (Controls) (Lines) (Strainers)		
<u>A</u>		<u>A</u>	13. CYLINDER HEAD AND GASKETS					<u>CS</u>	<u>CS</u>	48. WINCH (Clutch) (Brake) (Drive) (Controls) (Cable) (Guides)			
—		—	14. VALVE MECHANISM (Clearance) (Lubrication) (Cover Gaskets)					<u>C</u>	<u>C</u>	49. ELECTRIC MOTOR (Commutator) (Brushes) (Control Box) (Wiring)			
<u>CA</u>		<u>CA</u>	15. DIESEL FUEL NOZZLES AND LINES					<u>C</u>	<u>C</u>	50. GENERATOR (Commutator) (Brushes) (Control Box) (Wiring)			
—		—	16. SPARK PLUGS (Gaps) (Deposits)					<u>TCS</u>	<u>TCS</u>	51. REFRIGERATION UNITS (Drives) (Controls) (Valves) (Refrigerant)			
—		—	17. COMPRESSION TEST					—	—	52. VENTILATORS (Intakes) (Blowers) (Drives) (Ducts)			
—		—	18. ENGINE (Mounting and Braces) (Ground Strap) (Side Pane)					<u>DLA</u>	<u>DLA</u>	53. AIR COMPRESSOR (Valves) (Governor) (Lines) (Tank) (Drive)			
<u>T</u>		<u>T</u>	19. MANIFOLDS AND HEAT CONTROL (Intake) (Exhaust)					—	—	54. SUPERSTRUCTURE (Doors) (Hardware) (Glass) (Seats) (Safety Straps and Grab Rails) (Stowage Compartments) (Tarpaulins) (Ventilators) (Black Out Screens)			
<u>T</u>		<u>T</u>	20. EXHAUST PIPES AND MUFFLERS					—	—	55. HULL (Plugs) (Decks) (Ventilators) (Plates) (Compartments) (Bulkheads) (Frame)			
<u>D</u>		<u>D</u>	21. FUEL (Tanks) (Vents) (Lines)					<u>TCS</u>	<u>TCS</u>	56. RIGGING (Boom) (Blocks) (Cable) (Hoist)			
<u>CS</u>		<u>C</u>	22. FUEL FILTERS, SCREENS AND LINES					—	—	57. WIRING (Junction and Terminal Blocks) (Fuses and Spares)			
—		—	23. FUEL PUMP (Vacuum and Pressure)					<u>L</u>	<u>L</u>	58. HEATERS, FANS, AND DEFROSTERS			
<u>TAS</u>		<u>TA</u>	24. FUEL INJECTOR PUMP (Primer)					<u>TL</u>	<u>TL</u>	59. PLUMBING, FIXTURES, ETC.			
<u>LA</u>		<u>LA</u>	25. THROTTLE (Linkage) (Dual-Throttle Synchronization)					—	—	60. FIRE EXTINGUISHER SYSTEM (Tanks) (Valves) (Lines and Nozzles) (Mountings)			
<u>ST</u>		<u>T</u>	26. ENGINE OIL (Tanks) (Coolers) (Lines and Fittings) (Viscosity)					—	—	61. PAINT AND MARKINGS			
<u>CS</u>		<u>CS</u>	27. ENGINE OIL FILTERS (Reclaimers)					—	—	62. COMPASS (Fluid) (Lamp)			
<u>S</u>		<u>S</u>	28. AIR CLEANERS (Carburetor) (Diesel) (Air Compressor)					—	—	63. TOW (Chain) (Cable) (Rope) (Block)			
<u>TA</u>		<u>TA</u>	29. WATER PUMPS (Fresh Water) (Sea Water)					—	—	64. ANCHOR, HAND BILGE PUMP AND BOAT HOOK			
<u>A</u>		<u>A</u>	30. ACCESSORY DRIVES (Belt) (Pulleys) (Shafts and Couplings)					—	—	65. TOOLS AND EQUIPMENT			
<u>CT</u>		<u>CT</u>	31. HEAT EXCHANGER (Core) (Shutters) (Hose) (Cap) (Zinc Plate) (Scale)					—	—	66. FIRST AID KIT AND LIFE PRESERVERS			
<u>CT</u>		<u>CT</u>	32. FRESH WATER EXPANSION TANK (Antifreeze) (Cap) (Hose)										
<u>CT</u>		<u>CT</u>	33. GENERATOR (Commutator) (Brushes) (Wiring)										
—		—	34. REGULATOR UNIT (Connections) (Voltage) (Current) (Cut-Out)										
—	—	35. CARBURETOR (Choke) (Throttle) (Linkage) (Governor)											

NOTE: For craft having only one engine, one copy of this work sheet is sufficient for the entire craft at any one time. For craft having more than one engine, propulsion or auxiliary, one copy should be used for each engine, non-applicable parts of the form being disregarded.

REMARKS (For additional space use reverse side)

Figure 3. Front side of WD, AGO Form 55-125, Preventive Maintenance Service and Technical Inspection Work Sheet for Marine Craft.

SPECIAL MAINTENANCE			
1. Lube oil change engines: Oil is to be changed in accordance with "Lubrication Order" using oil meeting U. S. Army Specification 2-104B, or latest revision.			
2. Lube oil filters: Do not wash filter bags for reuse. Clean metal type filters.			
AFTER 1200-HOUR OPERATION OR SEMI-ANNUALLY			
3. Fuel injectors: Remove, clean, inspect and check.			
4. Intake and Exhaust Valves: Remove, inspect, clean and check.			
5. Connecting rods: Check clearances.			
AFTER 2400 HOURS OR ANNUALLY			
6. General Overhaul. (a) Remove engine heads, pistons and connecting rods; clean, check, replace piston rings and grind valves.			
(b) Clean gear cases and refill.			
SPECIAL INSTRUCTIONS			
1. Clean out generators, motors, and electrical controls with clean dry air of not more than 70 pound pressure.			
2. Caution is to be observed in lubricating the bearings of the generators. Over-lubrication is harmful to the bearings as it causes heating.			
3. Engine is to be cleaned periodically with suitable cleaning material as conditions warrant. Electrical equipment is to be kept free of oil. Do not use waste or linty rags when cleaning a diesel engine.			
4. Battery is to be cleaned with bicarbonate of soda solution (one (1) pound of soda to a gallon of water). Apply a thin coating of vaseline or cup grease to cable terminal.			
BATTERY			
VOLTAGE			ELECTROLYTE TEMP.
SPECIFIC GRAVITY			WATER ADDED (pts)
COMPRESSION TEST-P		COMPRESSION TEST-S	
ANTI-FREEZE PROTECTION			
MAN HOURS REQUIRED FOR 200-HOUR MAINTENANCE	1200-HOUR MAINTENANCE	TO (Number of degrees F)	NAME AND BADGE NO. OF MECHANIC OR INSPECTOR
REPAIRS REQUESTED (Date and Initials)	REPAIRS INITIATED (Date and Initials)	REPAIRS ACCOMPLISHED (Date and Initials)	
DISPOSITION OF WORK SHEETS: 200-Hour: May be retained until the completion of the next 1200 hour, then destroy.			
1200-Hour: May be retained until the completion of the next 1200 hour, then destroy.			
NOTE: A record of all maintenance, including date of oil change and amount of make-up crankcase oil used in engines and air compressors, is to be kept in the Craft Log Record.			
REMARKS			

Figure 4. Reverse side of WD AGO Form 55-125, Preventive Maintenance Service and Technical Inspection Work Sheet for Marine Craft.

items listed on WD AGO form 55-125. Second echelon personnel must be so thoroughly trained in these procedures that they will apply them automatically.

b. ONE FOR EACH ENGINE. For craft having only one engine, one copy of the form is sufficient for the entire vessel. For craft having more than one engine, either propulsion or auxiliary, one form should be used for each of these engines, non-applicable parts of the form being disregarded.

c. IDENTIFICATION DATA. All of the required identification data for the craft should be entered in the spaces provided at the top of each form.

d. INAPPLICABLE HEADINGS. In order to indicate on the work sheet whether one of the periodic preventive maintenance services or the technical inspection is being performed, line out the main items or sub-items that do not apply to the service or inspection to be performed.

e. USE OF BOXES. Boxes are placed opposite each item on the work sheet. These boxes indicate which of the maintenance or inspection services is to be performed for each item. Each box indicates that the item is to be inspected and corrected when necessary. Special service symbols like C, T, A, L, or S appear in some of the boxes. These symbols indicate that certain additional mandatory services are to be performed, and are explained in detail in *n*, below.

f. PERFORM IN SEQUENCE. Items not lined out on the form should usually be performed in the order in which they are listed, since they have been arranged for economy of motion.

g. ACTION ON DEFECTS. All defects should be corrected upon discovery or should be reported to higher echelons for correction.

h. MARKINGS. The condition in which items are found and the correction of defects should be indicated on the form by the following markings:

✓—Mark the box with a check if found satisfactory

X—Mark the box X if adjustment is required

XX—Mark the box XX if repair or replacement is required

⊗ or ⊗⊗—When a defect is found and not corrected immediately

or if the correction is to be made by higher echelon, mark the box with X or XX, whichever

is appropriate, and explain under REMARKS on the reverse side of the form. Record the item number for identification. When the defect is corrected, either by organization mechanics or by higher echelon mechanics, draw a circle around the X or XX, as follows: ⊗ or ⊗⊗.

i. DETERMINING ECHELON. The following considerations will govern in determining whether a maintenance operation should be referred to a higher echelon or be performed by the operating organization. Repair to craft will be performed in the lowest echelon of maintenance consistent with:

- (1) Availability of suitable tools,
- (2) Availability of necessary parts,
- (3) Capabilities of mechanics,
- (4) Time available,
- (5) Tactical situation.

j. RETURN TO OPERATION. After a technical inspection, the craft should be restored to a safe operating condition, unless it is to be deadlined for repair. Any disassembled parts or assemblies that are damaged in handling during the inspection should be replaced by serviceable ones.

k. MINIMUM DISASSEMBLY. The preventive maintenance services should be performed without disassembling units, unless prescribed in the procedures, or unless disassembly should be made in accordance with instructions in the craft manual. Ordinarily, new gaskets should be used when the parts are reassembled.

l. NEW INSTALLATIONS. When new or overhauled sub-assemblies are installed to correct deficiencies, care should be taken to see that they are clean, properly lubricated, and adjusted.

m. RELATED ITEMS. The general inspection of each item applies also to any supporting member or connection, and usually includes a check to see whether the item is in good condition, correctly assembled, secure, or excessively worn. Mechanics must understand thoroughly the meaning of these terms. The terms are defined in paragraph 6c.

n. SPECIAL SYMBOLS. Special service symbols, as applied to the items of the periodic preventive maintenance services, indicate that the part is to receive certain mandatory services. For example: An inspection box with a T in it indicates that the part not only must be secure, but that the mount-

ing bolts must be tightened properly with a wrench. These symbols are:

(1) *A, Adjust.* Make all necessary adjustments in accordance with the craft manual, special bulletins, or other directives.

(2) *C, Clean.* Clean units of the craft to remove lubricant or dirt, using dry-cleaning solvent. After the parts are cleaned, rinse them in clean fluid and dry them well. Be careful to keep the parts clean until reassembled. Keep cleaning fluid away from rubber or other material which it will damage. Clean the protective grease coating from new parts. This material usually is not a good lubricant.

(3) *L, Special Lubrication.* Special lubrication applies either to lubrication operations that do not usually appear on the craft Lubrication Order, or to items that do appear on the Order but should be performed in connection with the maintenance operations if parts have to be disassembled for inspection.

(4) *S, Serve.* This usually consists of performing special operations, such as replenishing battery water, draining and refilling units with oil, and changing or cleaning the fuel or oil-filter cartridge, strainers, tanks, etc.

(5) *T, Tighten.* All tightening operations should be performed with sufficient wrench torque (force on the wrench handle) to tighten the units according to good mechanical practice, using the proper tool without additional extension handle. Use torque-indicating wrench where specified. Do not overtighten, since this may strip threads or cause distortion. Tightening will always be understood to include the correct installation of lock washers, lock nuts, and cotter pins or locking wires provided to secure the tightening.

o. PARTIAL MAINTENANCE. When conditions make it difficult to perform the complete preventive maintenance service at one time, it may be done in installments. Efforts should be made to

complete all operations within the week if possible. All available time must be utilized if necessary to assure that the maintenance operations are completed. When limited by the tactical situation, items marked with special service symbols in the boxes should be given first consideration.

p. DISASSEMBLED UNITS. If it is necessary to disassemble a unit, any special services indicated on the 1200-hour maintenance should be performed.

q. DISPOSITION OF FORMS. All 200-hour maintenance work sheets may be held in the organization file until the next 1200-hour maintenance work sheet is filed. The old sheet may then be destroyed. The 1200-hour maintenance work sheet, or technical inspection report, may be held until the next 12000-hour maintenance form is filed, and then may be destroyed.

16. Specific Procedures

Specific procedures for performing each item in the monthly (200-hour) and semiannual (1200-hour) maintenance services, and in the technical inspections are described on the following pages. The three columns at the left of each page correspond to the columns provided in WD AGO Form 55-125 for indicating items to be covered in the 200-hour maintenance, the 1200-hour maintenance, and the technical inspection. While the 1200-hour maintenance and technical inspection are included in the same column on the work sheet, separate columns for these items are provided in the following pages. Often it will be found that a particular procedure does not apply to both the 200-hour maintenance, the 1200-hour maintenance, and the technical inspection. The sample below, taken from the specific procedures on the following pages, illustrates the application of these procedures. The numbers appearing under the columns at the left are the numbers of the items listed on the form.

SAMPLE

Tech. Insp.	1200 Hour	200 Hour		Remarks
24	24	24	<p>FUEL INJECTOR PUMP (PRIMER). Note whether the pump (including any transfer pump) is in good condition, correctly assembled, and securely mounted. See that its connections do not leak. Determine the oil level in the pump with the dip stick. Add oil if needed.</p>	<p>Applies to 200-hour maintenance, 1200-hour maintenance and technical inspection.</p>
	24	24	<p><i>Tighten.</i> Tighten all assembly and mounting bolts and cap screws.</p> <p><i>Adjust.</i> Adjust the fuel injector pump timing according to the instructions and specifications in the craft manual. Note whether hand pump primer is in good condition and in operating order.</p>	<p>Applies to both 200-hour and 1200-hour maintenance.</p> <p>Applies to both 200-hour and 1200-hour maintenance.</p>
	24		<p><i>Serve.</i> Drain the oil from the fuel injector pump and refill to correct level with specified engine oil.</p>	<p>Applies to 1200-hour maintenance only.</p>

SPECIFIC MAINTENANCE PROCEDURES

Tech. Insp.	Engine Running		
	1200 Hour	200 Hour	
1	1	1	<p>AIR PRESSURE (Build Up) (Governor Cut-Off) (Low Pressure Indicator). During the warm-up period operate the engine at idling speed and observe whether the air pressure builds up at a normal rate to the specified maximum limits, and whether the governor then cuts off to stop compressing action. Observe whether the pressure indicator registers the approximate pressure as pressure is built up to the maximum limit.</p>
2	2	2	<p>INSTRUMENTS AND GAUGES (Oil Pressure, Oil Temperature, and Hour Meter) (Ammeter and Voltmeter) (Tachometer and Revolution Counter) (Engine Temperature) (Fuel Oil Pressure) (Fuel).</p> <p><i>Oil Pressure, Oil Temperature and Hour Meter.</i> Observe the oil pressure and temperature to determine whether it is sufficient for safe operation of the engine, and whether the hour meter registers the accumulating engine running hours. Continue to observe the oil pressure and temperature to see that it is normal throughout the engine speed range. Also observe whether the hour meter continues to register at all times when the engine is running. <i>Caution:</i> If the oil pressure gauge indicates excessively low oil pressure, stop the engine immediately and investigate the cause.</p> <p><i>Ammeter and Voltmeter.</i> See that the ammeter and voltmeter are indicating normally. With the battery fully charged, charge should be indicated by ammeter for a short time after starting the engine (to restore the current used by the starter); the ammeter should return to slightly above zero, with all lights and electrical accessories switched off. When the battery is low, charge will be indicated for a longer period.</p> <p><i>Tachometer and Revolution Counter.</i> Observe the tachometer to see whether it operates normally without excessive fluctuation or unusual noises that might indicate worn or damaged gears or drive cables. Also observe the revolution counter to see whether it registers the accumulating revolutions.</p> <p><i>Engine Temperature.</i> Note the engine temperature gauge and exhaust temperature gauge (pyrometer) to see that they indicate in the normal range. The engine temperature should increase gradually during the warm-up period and normally should not exceed 180°F. The temperature at which the gauge hesitates indicates the opening of the thermostatic control.</p> <p><i>Fuel Oil Pressure, Fuel.</i> Observe whether the fuel gauges indicate the approximate amount of fuel in the tanks and determine whether the fuel pressure is sufficient for the proper operation of the engine.</p>
3	3	3	<p>WINDSHIELD, WINDSHIELD WIPER, HORN. See that the windshields are in good condition and secure, that the windshield glass is clean, that the wipers operate correctly through their full stroke without evidence of looseness in their motor mountings, and that the blades contact the glass properly. If the tactical situation permits, sound the horn to determine whether the signal is normal.</p>
4	4	4	<p>CLUTCH DRIVE (Free Travel) (Linkage). Observe whether the clutch lever has satisfactorily free travel (in accordance with the craft manual) before beginning to disengage or engage the clutch; see that it releases the clutch completely before the lever has completed its stroke and note whether there are any unusual noises in the clutch release mechanism that would indicate dry or defective release bearings, defective clutch plate or pilot bearings. When engaging the clutch, and when the clutch is fully engaged, observe whether there is any indication of slipping and whether linkage is properly adjusted.</p>
5	5	5	<p>GEAR DRIVE (Lever Action) (Declutching) (Vibration) (Noise) (Control Synchronization). With the craft in motion, operate levers of the driving units through all positions, noting whether the levers move easily and snap into each position. Observe whether there are any unusual vibrations that might indicate loose mountings, and whether the gears jump out of mesh. On multiple-engine-installations equipped with hydraulic or air controls, observe whether they appear to shift properly and whether the transmissions shift simultaneously. Continue these observations throughout the test.</p>
6	6	6	<p>STEERING (Gear) (Control) (Linkage). Steering wheel should have minimum free play in accordance with craft manual. Rotate the steering wheel fully in both directions and note any indication of binding or bumpy feel. Examine the steering column and steering wheel to see that they are in good condition and secure. On booster control unit, observe the free play of the steering gear to see whether there is excessive lash in the steering mechanism, or any indication of binding. Notice whether the steering booster appears to operate properly to assist the steering mechanism, and notice any abnormal pull to one side.</p>

Tech. Insp.	Engine Running		
	1200 Hour	200 Hour	
7	7	7	<p>DIRECT DRIVE REVERSE GEAR MECHANISM. Operate the engine in both forward and reverse positions, observing whether fuel cut-off is automatic when stopping and reversing the engine. Observe the automatic braking of the engine, valve operation, interlocking reverse cycle sequence, pneumatic and manual speed regulation, and maneuvering controls for proper functioning.</p>
8	8	8	<p>AIR CONTROL (Controlair) (Actuator) (Pneudyne) (Valves). Inspect these items for proper operation, and be sure that they are in good condition, correctly assembled, secure and adequately lubricated. Observe the action of:</p> <p><i>Controlair</i>, for proper control of maneuvering and speed regulation of the engine. <i>Actuator</i>, for proper regulation of engine speed, as selected from the Controlair. <i>Pneudyne</i>, for proper positioning of the engine camshaft and camshifting interlock and for shifting of engine clutch in accordance with the lever position of the Controlair. <i>Camshifting Interlock Valve</i>, for the proper interlocking of pneumatic control equipment with the engine camshaft position. <i>Throttle Latch Pilot Valve</i>, for the proper operation of fuel cutoff valve when changing engine direction. <i>Fuel Cutoff Valve</i>, for the proper shutoff and control of fuel when engine is stopped, started or reversed. <i>Relay Air Valve</i>, for the proper control of air as directed by the Controlair lever. <i>Reducing Valves</i>, for the proper limiting of air pressure to Controlair and Pneudyne in accordance with craft manual.</p>
9	9	9	<p>SUPERCHARGER (Operation) (Lube) (Vibration). Observe operation of the supercharger, paying particular attention to vibration of rotors, indicating loose or worn parts or marred surfaces. Examine drive and coupling assembly for indications of excessive lash. Inspect unit for loose mounting, oil leaks, proper and adequate lubricant.</p>
10	10	10	<p>ENGINE (Idle) (Acceleration) (Power) (Noise) (Smoke) (Governed Speed). <i>Idle.</i> Observe whether the engine runs smoothly at idling speed and listen for knocks and rattles as the engine is accelerated and decelerated and while it is under light and heavy loads. <i>Acceleration, Power, and Noise.</i> Observe whether the engine has normal acceleration, pulling power, and operating characteristics in each speed. Listen for other noises that might indicate damaged, excessively worn, inadequately lubricated engine parts or accessories, or loose drive belts. <i>Smoke.</i> During operation of the engine test, look for any indication of excessive or unusual smoke from the exhaust. <i>Governed Speed.</i> Slowly accelerate the engine and observe the tachometer reading. Notice that engine reaches but does not exceed the governed speed (rpm) specified on the caution plate or recommended by the craft manual. Do not accelerate engine beyond fast idle without load.</p>
11	11	11	<p>SAFETY DEVICES (Overspeed Safety Trip) (Low Oil Safety Shutdown). <i>Overspeed Safety Trip.</i> With engine running, trip the overspeed safety trip to make sure that all parts are in working order. Reset trip lever. Examine linkage and controls for adequate lubrication. <i>Low Oil Safety Shutdown.</i> Test cut-out switch for low oil safety and excessive water temperature, to insure that all parts and units are in working order. Examine horn or howler if used in connection with switch. Any deficiencies in the operation of the safety devices must be corrected before engine is started again.</p>
12	12	12	<p>LEAKS (Fuel Oil) (Engine Oil) (Water) (Air). Check the engine compartment thoroughly, including the entire engine, for indications of oil, air, water, or fuel leaks and determine their source. This should be corrected or reported to the proper authority.</p>
13	13	13	<p style="text-align: center;"><i>Engine Stopped</i></p> <p>CYLINDER HEAD AND GASKETS. Look for cracks or indications of oil, water, or compression leaks around studs, cap screws, and gasket. <i>Caution:</i> Cylinder heads should not ordinarily be tightened unless there is a definite indication of looseness or leaks. If tightening is necessary, use a torque-indicating wrench and tighten in the sequence and to the tension specified in the craft manual. When a new gasket is installed, tighten three times as follows: First, upon installation; second, after engine is warmed up, and third, after completing final test. On valve-in-head engines, adjust the tappet clearances to specifications after the final tightening of the head nuts.</p>

Tech. Insp.	Engine Running		
	1200 Hour	200 Hour	
14	14	14	VALVE MECHANISM (Clearances) (Lubrication) (Cover Gaskets). On valve-in-head engines, examine valve tappet clearances while hot. Valve tappets, rocker arms, shafts, and springs should appear in good condition, correctly assembled, and secure. Oil should be delivered properly. Also make sure that the valve cover gaskets are in good condition. On L-Head engines perform the above service only as the need for such service is indicated by valve noises or engine performance. Remove valve mechanism covers, observe valve clearances and condition of valve mechanism.
	14	14	<i>Adjust.</i> Adjust the clearances to specifications, taking care that the lock nuts are secure when the clearances are last noted during the adjustment.
15	15	15	DIESEL FUEL NOZZLES AND LINES. Observe whether these items are in good condition, secure, and do not leak.
	15		Use fuel nozzle test stand, if available, taking every precaution to keep spray away from personnel. Observe whether there is any "after-dribble" from the spray nozzle. If the spray pattern is not normal or a dribble occurs, the nozzle should be replaced by a new or reconditioned and tested nozzle. Tighten all fuel nozzle mounting nuts, cap screws, and line connections securely.
16	16	16	SPARK PLUGS (Gaps) (Deposits). <i>Spark Plugs.</i> Examine the installed spark plugs to see that their insulators are in good condition and clean, and that there is no leakage around the insulators or gaskets. When operating conditions require, the spark plugs may be removed for service.
16	16	16	Remove the spark plugs and examine for poor condition, paying particular attention to broken insulators, excessive carbon deposits, and electrodes which are burned thin. Replace unserviceable plugs. Report excessive deposits or damaged insulators. These conditions may indicate incorrect heat range. The porcelain insulators inside spark plugs of proper heat-range will be coffee-brown in color.
	16	16	<i>Clean.</i> Clean deposits from the electrodes and insulators, and inspect again for cracks. If a plug cleaner is not available, install new or reconditioned plugs.
	16	16	<i>Adjust.</i> Adjust gaps to specifications. After completing Item 17, reinstall the plugs, using new gaskets and taking care not to overtighten them, as this may cause distortion and damage.
17	17		COMPRESSION TEST <i>Gasoline.</i> With all spark plugs out and engine warm, insert the compression gauge in a spark plug hole, and with the throttle wide open, revolve the engine at cranking speed until the maximum compression is indicated. Record the reading in the space provided on the back of the form. Repeat this process for each cylinder. Refer to the craft manual for specified compression pressures and for variations due to condition and wear. If pressure in a cylinder is below normal, squirt sufficient engine oil on the piston head to temporarily prevent loss of compression, and recheck the compression of the cylinder. Low compression brought up to normal by oil sealing indicates piston, ring, or cylinder wear or damage. Low compression not brought up to normal by this method indicates compression leakage by valve or gasket.
			<i>Diesel.</i> Attach pressure indicator to cylinder, turn scale sleeve to bring red disk in register with letter "C" for compression readings. (Note: Set index sleeve to read about 50 to 100 pounds per square inch in excess of the expected maximum cylinder pressure.) Connect neon flasher to indicator valve and obtain reading of cylinder pressure. Repeat this process for each cylinder. Record the reading in the space provided on the back of the form. Where the pressure indicator cylinder valve is not on the unit, use compression gauge and proceed as for gasoline engines.
18	18	18	ENGINE (Mounting and Braces) (Ground Strap) (Side Pans). See that engine is properly installed, taking care that all mountings and ground straps are securely tightened. Be sure engine side pans, if present, are in good condition, correctly assembled and do not leak.
19	19	19	MANIFOLDS AND HEAT CONTROL (Intake) (Exhaust). Note whether the manifolds and their gaskets are in good condition, correctly assembled, secure, and do not leak. Check for indication of leaks by looking for carbon streaks. Check exhaust temperatures and temperature gauges. Equalize cylinder exhaust temperatures to the minimum appreciable variations. On a manually operated heat control determine if it is in good condition, secure, and set at the correct position. If the control is automatic, note whether the bi-metal control spring is in good condition and securely connected to the heat-control valve shaft and mountings. See that the shaft operates freely and that the spring controls the shaft properly.
	19	19	<i>Tighten.</i> Tighten all manifold assembly, mounting, exhaust pipe, and carburetor connecting flange nuts evenly and securely.
20	20	20	EXHAUST PIPES AND MUFFLERS. Note whether they are in good condition, securely assembled, and mounted, and whether there are indications of exhaust leaks, usually indicated by carbon streaks. Be sure the drain holes in the mufflers are not clogged, so that all condensate may drain off.
	20	20	<i>Tighten.</i> Tighten all mounting bolts and connections securely.

Tech. Insp.	Engine Running		
	1200 Hour	200 Hour	
21	21	21	FUEL (Tanks) (Vents) (Lines). Inspect fuel tanks to see that they are in good condition and securely mounted. Examine caps for defective gaskets and note whether the vents are open and whether there are indications of fuel leaks from the tanks, lines or pumps. See that the filler necks are in good condition and the caps fit securely. Inspect fuel lines and fittings to see that they are in good condition, securely supported, and not leaking.
		21	<i>Drain.</i> Remove the fuel tank drain plugs and drain off the accumulated water and sediment. Drain only until the fuel starts to run clean.
22	22	22	FUEL FILTERS AND SCREENS. Note whether the fuel filters and cleaner bowls are in good condition, secure, and not leaking at gaskets or connections.
		22	<i>Clean.</i> Remove fuel screens and cartridge-type elements, clean all screens thoroughly in dry-cleaning solvent, dry with compressed air, and reinstall. Observe whether the cartridge-type element is in satisfactory condition for further service. If so, clean and replace it, being sure that all element and cover gaskets are in good condition and in place. On disk-type filters, turn the handle one complete turn. Remove the plug, and drain the sediment bowl.
		22	<i>Serve and Clean.</i> On a cartridge-type fuel filter, replace the cartridge, and clean all fuel screens. On a disk-type filter, remove the element from the cleaner bowl, and wash in dry-cleaning solvent until the disks are clean and free. Clean the bowl thoroughly, and reinstall the element, making sure all gaskets are in good condition and in place. Do not scrape or damage the disks.
23	23	23	FUEL PUMP (Vacuum and Pressure). See that the fuel pump lines are in good condition, secure, and not leaking. Attach the fuel test gauge properly and with the engine idling note whether the pump pressure is within specified limits, which are listed in the craft manual. Replace any pump that does not produce proper pressure, being sure to make a similar check of the new pump to see that it is satisfactory.
24	24	24	FUEL INJECTOR PUMP (Primer). Note whether the pump (including any transfer pump) is in good condition, correctly assembled, securely mounted, and its connections do not leak. Determine the oil level in the pump with a dip stick. Add oil if needed.
		24	<i>Tighten.</i> Tighten all assembly and mounting bolts and cap screws.
		24	<i>Adjust.</i> Adjust the fuel injector pump timing according to the instructions and specifications in the craft manual. Note whether hand pump primer is in good condition and in operating order.
		24	<i>Serve.</i> Drain the oil from the fuel injector pump and refill to correct level with specified engine oil.
25	25	25	THROTTLE (Linkage) (Dual-Throttle Synchronization). See that the throttle and all of its connecting linkage are in good condition and securely connected. Also, on craft equipped with more than one engine, follow the instructions in the craft manual, and note whether the linkage is properly synchronized, so that the throttle valves open and close together. On those craft having automatic transmissions and transfer units, check according to instructions in the craft manual to see whether the throttle control linkage is properly synchronized with the controls of these units.
		25	<i>Adjust.</i> On craft equipped with automatic transmission and transfer units, follow the instructions in the craft manual, and adjust the relationship between controls of these units and the acceleration linkage so that they are properly synchronized.
		25	<i>Lubricate.</i> Lubricate all linkage pins, fulcrums, joints and other connections requiring lubrication. Refer to craft manual and Lubrication Order.
26	26	26	ENGINE OIL (Tanks) (Coolers) (Lines and Fittings) (Viscosity). Observe whether they are in good condition, correctly assembled, securely mounted, and whether there are indications of oil leaks. Measure the level of the oil in the supply tanks with the bayonet gauge. Inspect a sample of oil for grit, water or fuel dilution, and determine the viscosity with the use of "visgage."
		26	<i>Tighten.</i> Tighten all oil tank mountings and oil line support clips or brackets securely.
		26	<i>Serve.</i> Drain all oil from the supply tanks, close the drain cocks, and fill tank approximately one-fourth full with light engine oil. Agitate with a clean stick or rod to loosen the sediment. Continuing to stir the oil, open the drain cock and drain the oil and sediment from the tanks. After flushing oil is thoroughly drained, close the drain cocks and fill the tanks to the proper level with specified engine oil.
			<i>Note:</i> If crankcase oil change is due, drain the crankcase and refill to the proper level with specified oil. Do not start the engine again until Item 27 is completed.
27	27	27	ENGINE OIL FILTERS (Reclaimers). Inspect oil filters, coolers, and all external engine oil lines to see whether they are in good condition, secure and do not leak.
		27	<i>Clean.</i> On disk type filters, turn the handle one complete turn, remove the drain plug, and drain off the contents.

Tech. Insp.	Engine Running		
	1200 Hour	200 Hour	
	27	27	<i>Clean and Serve.</i> When due or when oil filter cartridge condition indicates a filter cartridge change is necessary, remove the filter cartridge, clean the case with solvent and install a new filter cartridge of the correct type, installing new gaskets and tightening the cover securely. On disk type filters, remove the cover and element and without disassembling, clean them in dry-cleaning solvent. Blow dry with compressed air if available. If the element is serviceable, reinstall it; if not replace.
28	28	28	AIR CLEANERS (Carburetor) (Diesel) (Air Compressor). Remove all carburetor, Diesel, or air-compressor air cleaner elements. See that all gaskets, seals, clamps, and any connecting hose or tubes are present and in good condition. Observe the condition of the cleaning elements, baffles and body. Note the oil in the reservoir of oil-bath cleaners, paying particular attention to the amount of dirt present in the oil. Also see that the oil level is satisfactory.
	28	28	<i>Clean and Serve.</i> Wash cleaner element in dry-cleaning solvent, dry, apply engine oil to element, and drain excess oil. On oil-bath air cleaner, refill the reservoir to the correct level with clean engine oil. Reassemble, making certain all gaskets are in good condition and in place. Install air cleaner, being careful that it is pressed firmly into place and that the mounting is secure. If the air cleaner is equipped with an external air baffle, see that it is correctly aligned with the air stream. Also note whether connecting hose is in good condition and properly clamped to the air cleaner and horn.
29	29	29	WATER PUMPS (Fresh Water) (Sea Water). Inspect pumps to see that they are in good condition and secure. See that the drive, belt, and chain are in good condition and properly adjusted and that the pulleys and sprockets are in good condition, secure, properly aligned and not excessively worn. Examine shaft for end play and loose bearings. Note whether the valve control linkage is properly connected to the valves and operates them freely. Also see if the pump lines and strainers are in good condition, properly mounted, and secure. Particularly, see whether or not the strainers are clogged.
	29	29	<i>Adjust.</i> Adjust pump drive chain or belt according to instructions in craft manual.
	29	29	<i>Tighten.</i> Tighten all pump mounting and assembly bolts securely, and pump packing nuts cautiously. Over-tightening will score shafts and cause leaks.
30	30	30	ACCESSORY DRIVES (Belt) (Pulley) (Shafts and Couplings). See that these items are in good condition, correctly assembled, and secure. Pay particular attention to drive belts and pulleys, seeing that they are well aligned and not excessively worn. Also note whether they are frayed, oil soaked, improperly adjusted, or bottoming in the drive pulleys. See that the universal joints of drive shafts are not excessively worn or loose.
	30	30	<i>Adjust.</i> Adjust all drive belts according to instructions and specifications in the craft manual, locking all adjustment devices securely.
31	31	31	HEAT EXCHANGER (Core) (Shutters) (Hose) (Cap) (Zinc Plate) (Scale). See that these items are in good condition, correctly assembled, securely mounted and do not leak. If air cooled, note whether the core air passages are obstructed with dirt or trash. Examine the shutter control linkage to see that it is in good condition, secure, and operates freely. Note whether the steam relief valve operates freely and is in correct position for the prevailing atmospheric temperature. Also examine coolant to see whether it is contaminated with rust, oil, or other foreign matter that would require the cooling system to be cleaned. Examine zinc electrodes for deterioration and replace if necessary.
	31	31	<i>Clean.</i> If cleaning is necessary, clean the cooling system according to current directives, using only specified cleaner. Clean all dirt and trash from the exterior of the core.
	31	31	<i>Tighten.</i> Tighten all loose mountings, plates, and clamps.
32	32	32	FRESH WATER EXPANSION TANK (Antifreeze) (Cap) (Hose). See that the items are in good condition, correctly assembled, securely mounted and do not leak. Also examine the coolant to see whether it is contaminated with rust or other foreign matter which would require the system to be cleaned.
	32	32	<i>Clean.</i> If cleaning is necessary, drain, taking care to save drains to put back into radiator if ethylene glycol antifreeze is in use. Clean the cooling system according to current directives, using only specified cleaner. Flush cleaner from entire cooling system with clean water. Refill, adding specified inhibitor (if required) unless new antifreeze which contains inhibitor is used. If antifreeze is in use, determine its protective value and record in the space provided on the reverse side of the Work Sheet. Clean all dirt and trash from the exterior of the core.
	32	32	<i>Tighten.</i> Tighten all loose mountings, plates, and clamps.
33	33	33	GENERATOR (Commutator) (Brushes) (Wiring). Remove the brush head cover plate and check the commutator to see that it appears to be in good condition, clean, and not excessively worn. Observe whether the brushes are clean, free in their holder, properly spring loaded, and not excessively worn. Check giving connections for tightness and correct alignment of generator drive.
	33	33	<i>Clean.</i> At each 200 hour service, clean the commutator by placing a strip of very fine sand paper (00 to 8/0) over a wood block of the correct size. With the engine running slowly, press the sand paper against the commutator until it is clean. Blow out with compressed air.
	33	33	<i>Tighten.</i> Tighten mounting bolt, and electrical connections securely.

Tech. Insp.	Engine Running		
	1200 Hour	200 Hour	
34	34	34	REGULATOR UNIT (Connections) (Voltage) (Current) (Cut Out). See that they are in good condition and all connections and mountings are secure.
34	34		Connect the low voltage circuit tester and observe whether the voltage regulator, current regulator, and cut-out, control the generator output properly. Follow the instructions in the craft manual or those which accompany the test instrument. Replace if test shows faulty operation. NOTE: This test should be made only after the regulator unit has reached normal operating temperature.
35	35	35	CARBURETOR (Choke) (Throttle) (Linkage) (Governor). See that these items are in good condition, correctly assembled and securely installed; that the carburetor does not leak; that the control linkage, including the choke valve opens fully when the control is in its released position; that the throttle valve opens fully when the accelerating lever is fully depressed, and that the governor is secure and properly sealed. Drain the carburetor bowl and clean screen.
36	36	36	COIL AND WIRING (High and Low Voltage) (Supports). Examine the coil to see that it is in good condition, clean, and securely mounted. All high voltage ignition wiring, including shielding or conduits, should be in good condition and securely fastened to all support mountings and terminals. See that all insulation and connections are clean. Inspect all low voltage wiring in the engine compartment in the same manner. On engines equipped with magnetos, examine the booster coils to see that they are in good condition, clean, and securely mounted. <i>Note:</i> Do not tighten wiring connections unless actually loose, as overtightening of terminals will cause damage.
	36	36	<i>Clean.</i> Clean all exposed ignition wiring with a dry cloth or compressed air.
37	37	37	MAGNETOS (Points). Determine whether the magneto is in good condition and securely mounted. Note whether there is evidence of oil leaks at the mounting pad gaskets. Remove the breaker point inspection covers and check to see that the points are in good condition and clean; that the breaker points are well aligned; that the mating surfaces engage squarely; and that point gaps are satisfactory (refer to craft manual). Replace unserviceable points.
	37	37	<i>Adjust.</i> Adjust the magneto breaker-point gaps according to instructions and specifications in the craft manual.
38	38	38	DISTRIBUTOR (Cap) (Rotor) (Points) (Shaft) (Advance Units). See that the distributor body and external attachments are in good condition and secure. Inspect other parts of the distributor as follows: <i>Cap, Rotor, and Points.</i> Blow or wipe the dirt or dust from the distributor cap. Remove the cap, and observe whether the cap, rotor arm, and the breaker-plate assembly parts are in good condition, correctly assembled, secure, and serviceably clean. Pay particular attention to cracks in the cap and rotor arm, to corrosion of terminals, and connections in these parts; also to burning off of the outer ends of the conductor strap of rotor arm. Also note whether the breaker points are in good condition and well aligned, and that the gap is satisfactory. If the breaker-plate assembly is unserviceably dirty, remove the distributor, clean in dry-cleaning solvent, dry with compressed air, lubricate the parts as specified below, and reinstall the distributor in the correct position for timing. When cleaning the distributor, remove the wick and lubrication cup, clean and dry while removed, and reinstall them only after distributor assembly is cleaned and blown dry with compressed air. If the breaker points are pitted, burned, or worn to an unserviceable condition, install a new set. If the points are badly pitted, replace the condenser also, as it is probably the cause of the pitting. Install the new points so that they are well aligned and engage squarely. If the points are slightly pitted or burned, dress them with an American-Swiss No. 6 File (or equivalent) or No. 00 Sandpaper (do not use emery cloth), and blow off the filings with compressed air. <i>Shaft.</i> Test by hand-feel for looseness, to determine whether the distributor camshaft is excessively worn in its bushings. <i>Centrifugal Advance.</i> Install the rotor arm on the upper end of the distributor camshaft, and observe whether the camshaft can be rotated by finger force through the nominal range of movement which is permitted by the centrifugal advance mechanism, and whether it returns to its original position when the fingers are removed from the rotor arm. There should be no binding or hanging up in mechanism during these movements.
	38	38	<i>Special Lubrication.</i> Lubricate the cam surfaces, the movable breaker-arm pin, the wick, and the camshaft according to the craft's Lubrication Order. Take care to keep lubricant off the distributor points, not to apply more lubricant than is specified, and to wipe the cam clean before lubricating its surface.
	38	38	<i>Adjust.</i> Adjust the breaker-point gap to specifications. If suitable equipment is available, adjust dwell angle.

Tech. Insp.	Engine Running		
	1200 Hour	200 Hour	
39	39	39	<p>BATTERY (Cables) (Hold-Downs) (Gravity and Voltage). Inspect the batteries externally to see that their cases, posts, and cell straps are in good condition and secure. Note whether the cases are leaking. Wipe dirt from and around the filler caps, remove, and see that the cap vents are open. Note the level of electrolyte in the cells. This level should be above the top of the plates, and may extend up to one inch above the plates. Before adding any water to the cells, test the specific gravity of each cell, with a battery hydrometer, and record the gravity readings in the spaces provided on the reverse side of the work sheet. As the samples of the electrolyte are in the hydrometer for the gravity test, observe whether the electrolyte is discolored to a reddish-brown color, which may indicate that the battery is being overcharged due to improper regulator action. Report any gravity readings below 1.225 and variations of more than 0.025, and any reddish-brown discoloration of the electrolyte. Also take the voltage reading of each cell, and record it in the space provided on the reverse side of the work sheet. Examine the battery cables, terminals, and terminal bolts to see whether they are in good condition, secure, and not corroded; if the battery hold-downs are securing the battery properly; and that the battery carrier is in good condition and secure. If the terminals are corroded, disconnect the cable terminals from the battery, clean, and lubricate the battery posts and terminals, and reinstall them securely.</p>
39	39		<p>Make a high-rate discharge test of the battery to see that the cells are in a satisfactory condition, taking care to make the test according to the instructions for a condition test which accompany the test instrument. A true test cannot be made if the gravity of the battery is below 1.225. If the difference in the readings obtained from the cells is more than 30 percent, replace the battery.</p>
	39	39	<p><i>Clean.</i> Clean top of battery with water of a soda wash, if available, and dry with a clean water or compressed air. Clean the battery carrier in the same way, and paint if corroded. Clean the battery cable terminals, terminal bolts and nuts and battery posts and grease them lightly.</p>
	39	39	<p><i>Serve.</i> Bring the electrolyte to the correct level with distilled water, if it is available. If not available, use any clean fresh water in preference to letting battery run dry. Inspect bolts for serviceability. Tighten terminals and hold-downs carefully to avoid damage to battery.</p>
40	40	40	<p>AIR COMPRESSOR (Unloader Valve) (Governor) (Lines) (Tank). Examine the air compressor to see that it is in good condition, properly aligned with its drive pulleys, and secure. Observe the unloader valve for satisfactory valve clearance. See that the governor appears to be in good condition and secure; that all the compressor oil and air lines are in good condition and secure; and that the oil and air lines do not leak.</p>
	40	40	<p><i>Clean.</i> Clean the governor air strainer in dry-cleaning solvent; dry and reinstall. Drain water (condensation) from air-tank and lines.</p>
	40	40	<p><i>Special Lubrication.</i> Apply a few drops of engine oil on the unloader valve fulcrum pin.</p>
	40	40	<p><i>Adjust.</i> Adjust unloader valve clearances to specifications. (Refer to craft manual).</p>
41	41	41	<p>GEAR OIL LEVELS. Inspect and check all gear cases to see that the lubricant is at the proper level, in good condition and not leaking.</p> <p><i>Note:</i> Sufficient time should be allowed so that the normal foaming may subside. If an oil change in these units is due, drain and refill with specified lubricant. (Refer to craft manual for lubricant requirements and levels).</p>
42	42	42	<p>STARTING MOTOR (Air) (Electric) (Controls). Start the engine, observe whether the general action of the starter is satisfactory, particularly whether it engages or operates properly without excessive noise and has adequate cranking speed.</p> <p><i>Note:</i> As soon as the engine starts, note whether oil pressure gauge and ammeter indications are satisfactory. See that the starter is in good condition and securely mounted; that all connections are tight.</p>
	42	42	<p><i>Air.</i> See that the starting air valve, check valves, lines, and controls are properly mounted, in good condition, and secure. Pay particular attention to air delivery pressure, to determine whether adequate cranking speed is developed; examine entire system for leaks, or sticking air valve stems.</p>
	42	42	<p><i>Electric.</i> Remove the commutator inspection block and inspect the commutator to see that it is in good condition and clean. See that the brushes are clean, free in the brush holders, and not excessively worn; that the brush connections are secure and wires neither broken nor chafed.</p>
	42	42	<p><i>Handcrank Ratchet and Lever.</i> Examine these items to see that they are in good condition and secure, and that the cranking box and ratchet operate satisfactorily to rotate the engine.</p>
	42	42	<p><i>Clean.</i> Clean the commutator end of the starter with very fine sandpaper or with compressed air.</p>
	42	42	<p><i>Tighten.</i> Tighten the starter mounting bolts securely.</p>
	43		<p>TIMING (Diesel) (Gasoline). With the engine running and the neon timing-light properly connected, determine the ignition timing of each engine according to instructions in the craft manual or current directives to see whether it is correct. Also observe whether the automatic controls advance the spark as the engine is accelerated gradually. When necessary, adjust the ignition timing to the specifications in the craft manual, taking care to see that the distributor is well secured when adjustment is completed. On engines equipped with magnetos, the timing is adjusted when the magnetos are installed.</p>

Tech. Insp.	Engine Running		
	1200 Hour	200 Hour	
			<i>Diesel.</i> Bar engine over in direction of normal travel, the specified degrees (°) before top dead center for #1 cylinder. Check or adjust timing of fuel injection pump and nozzles according to instructions and specifications in craft manual.
44	44	44	BILGE PUMPS (Drives) (Valves) (Control) (Lines) (Strainers). Inspect the bilge pumps to see that they are in good condition and secure; see that the drive belt and chain are in good condition and properly adjusted; and that the pulleys and sprockets are in good condition, secure, properly aligned, and not excessively worn. Note whether the valve-control linkage is properly connected to the valves and operates them freely. Also see that the bilge pump lines and strainers are in good condition, properly connected, and secure. Pay particular attention to the strainers to see if they are clogged.
	44	44	<i>Tighten.</i> Tighten all pump mounting and assembly bolts securely, and pump-packing nuts cautiously. Over-tightening will score shafts and cause leaks.
	44	44	<i>Adjust.</i> Adjust pump-drive chain or belt according to instructions in the craft manual.
45	45	45	PROPELLER (Seals) (Joints) (Bearings) (Stuffing Box). Observe whether they are in good condition, correctly assembled and secure. Pay particular attention to the alignment, the bearing mountings, stuffing box and propeller shaft tunnel bearings. See that the propeller drive control and coupling are in good condition, operate correctly and are not excessively worn. Note whether the thrust or forward bearings are excessively worn, and correctly lubricated.
	45	45	<i>Tighten.</i> Tighten the stuffing box packing flange cautiously. Do not overtighten since this may cause stuffing box to run hot, score the shaft, and cause leaks.
46	46	46	RUDDER (Shafts) (Arms) (Cables) (Cable Sheaves) (Rod) (Brackets) (Controls). See that these items are in good condition, correctly assembled and securely mounted; that the control linkage and cable sheaves are adequately lubricated, and that the stuffing box does not leak. Look particularly for worn or broken cable strands. Turn the steering wheel to its maximum right and left positions; see that the rudder lever has about the same clearance in each position. If not, readjust the cables according to specifications. Check emergency steering devices.
	46	46	<i>Tighten.</i> Tighten all rudder and control assembly and mounting bolts securely. Tighten the rudder shaft stuffing box packing nut cautiously. Over-tightening may cause excessive binding and leaks.
47	47	47	<i>Auxiliaries</i>
	47	47	PUMPS (Drives) (Valves) (Controls) (Lines) (Strainers). Inspect all pumps to see that they are in good condition and secure. See that the drives are in good condition and properly adjusted and that the pulleys and sprockets are in good condition, secure, properly aligned, and not excessively worn. Note whether the valve control is properly connected and operates freely. Also see that all pump lines and strainers are in good condition, properly connected, and secure. Inspect all strainers, screens, valves to see whether or not they are clogged.
	47	47	<i>Tighten.</i> Tighten all pump mounting and assembly bolts securely, and pump packing nuts cautiously. Overtightening will score shaft and cause leaks.
48	47	47	<i>Adjust.</i> Adjust drives according to instructions in craft manual.
	48	48	WINCH (Clutch) (Brake) (Drive) (Controls) (Cable) (Guides). Observe whether they are in good condition, correctly assembled, and secure. See that the clutch moves freely to both the engaged and disengaged positions and that it latches securely. Examine the drag brake lining to see that it is in good condition, secure, and correctly adjusted to stop the drum. Inspect the automatic brake to see that lining is secure and not excessively worn, and that the band is in place with its spring and adjusting nuts. Inspect the cable for good condition, even winding, and note whether the cable chain and hooks are securely attached and in good condition. Examine the cable guides for good condition and secure mountings. Also check the oil level in the worm gear case. Add or drain lubricant as necessary to bring to correct level.
	48	48	<i>Serve and Clean.</i> Unwind the cable and inspect it for broken or frayed strands and for flat or rust spots. Clean the entire length of the cable with a cloth saturated with fuel oil or solvent. Rewind the cable on the drum evenly, at the same time applying a thin film of cable oil. Drain the worm gear case and refill to correct level with specified oil. (Refer to craft manual for correct lubricants and levels).
49	49	49	<i>Note:</i> On landing craft, ramps, and ramp locks, the winches, cables, and sheaves must be inspected, served, and cleaned.
	49	49	ELECTRIC MOTOR (Commutator) (Brushes) (Control Box) (Wiring). Start the motor, observing whether it starts easily and runs at normal speed, and listen for any unusual noise that might indicate excessively worn, loose, or inadequately lubricated parts. Remove brush head cover plate and check the commutator to see that it appears in good condition, clean, and not excessively worn. Observe whether the brushes are clean, free in their holders, properly spring-loaded, and not excessively worn. Inspect the control box, buttons, and wiring to see that they are in good condition, correctly assembled, connected, and secure.
	49	49	<i>Clean.</i> At each 200 hour service, clean the commutator by placing a strip of very fine sandpaper (00 to 8/0) over a wood block of the correct size; with the motor running, press the sandpaper against the commutator until it is clean. Blow out the dust with compressed air.

Tech. Insp.	Engine Running		
	1200 Hour	200 Hour	
50	50	50	GENERATOR (Commutator) (Brushes) (Control Box) (Wiring). Start the generator, observing whether it starts easily and runs at normal speed, and listen for any unusual noise that might indicate excessively worn, loose, or inadequately lubricated parts. Remove brush head cover plate and check the commutator to see that it appears in good condition, clean and not excessively worn. Check the generator output. Inspect the control box and buttons, ammeter and wiring to see that they are in good condition, correctly assembled and connected, and secure.
	50	50	<i>Clean.</i> At each 200-hour service, clean the commutator by placing a strip of very fine sandpaper (00 to 8/0) over a wood block of the correct size; with the motor running, press the sandpaper against the commutator until it is clean. Blow out the dust with compressed air.
51	51	51	REFRIGERATION UNITS (Drives) (Controls) (Valves) (Refrigerant). Inspect these items to determine whether they are in good condition, correctly assembled and secure. Observe whether there are any indications of excessively worn, loose, or improperly lubricated parts. Examine controls, regulating and expansion valves, diaphragms and tubes, for serviceability and safe operating conditions.
	51	51	<i>Tighten.</i> Tighten all mounting bolts, braces and connections. Examine for oil, water, and gas leakage, and tighten, or repair, or report to proper authority.
	51	51	<i>Serve and Clean.</i> Clean water condenser tubes; see that expansion valves are properly regulated; replace if worn. Check for gas shortage; test refrigerant and add liquid if short. Check oil in circulating system and lubricate in accordance with lubrication order or instructions in craft manual.
52	52	52	VENTILATORS (Intakes) (Blowers) (Drives) (Ducts). Inspect and check these items for proper operation, correct mounting, excessively worn or improperly lubricated parts. Examine drive units for excessive vibration or excessive lash. Observe whether drive units, controls, regulators, ducts, screens, and intakes are properly mounted, secure, and clean. Tighten all mountings, braces, bolts, and supports. Tighten and adjust drives, belts, pulleys, and accessories.
53	53	53	AIR COMPRESSOR (Valves) (Governor) (Lines) (Tank) (Drive). See that air compressor is in good condition, properly aligned with its drive pulleys, and secure. Observe whether the unloader valve has satisfactory clearance. Inspect all valves and connections for leaks. See that the governor appears to be in good condition and secure; that all oil and air lines are in good condition, secure, and do not leak.
	53	53	<i>Drain.</i> Drain water (condensation), sludge, and oil from lines, separators, and tanks.
	53	53	<i>Special Lubrication.</i> Apply a few drops of engine oil on the unloader valve fulcrum pins.
	53	53	<i>Adjust.</i> Adjust unloader valve and governor clearances to specifications. (Refer to craft manual).
<i>Hull Superstructure and Accessories</i>			
54	54	54	SUPERSTRUCTURE (Doors) (Hardware) (Glass) (Seats) (Safety Straps and Grab Rails) (Stowage Compartments) (Tarpaulins) (Ventilators) (Black-out Screens). Inspect these items to see that they are in good condition and secure; that the hardware and ventilators operate properly and are adequately lubricated; and that the doors engage their bumpers and strikers and latch properly in the closed position. Check safety straps and grab rails for correct mounting and secure them. Observe that all black-out screens and accessories are properly mounted, operate freely and completely obstruct any glare or reflection. Pay particular attention to tarpaulin condition and see that all fasteners, ropes, grommets and loops are present, in good condition and secure. See that stowage compartments, covers, and doors are properly aligned and hinges and latches adequately lubricated.
55	55	55	HULL (Plugs) (Decks) (Ventilators) (Plates) (Compartments) (Bulkheads) (Frame). Examine the hull to see that it is in good condition. Pay particular attention to bulges that might cause leaks. See that hull sea cocks and plugs are in place and secure, and note their condition. Inspect the deck and hatch covers for good condition and see that they are properly aligned with their openings. Check deck ventilators to the engine compartment for good condition and proper operation; see whether the screens are clogged and whether the cover seals properly when closed. Examine hull compartments to see that the hull, frame, reinforcement plates, and bulkheads are in good condition and secure. Look for indications of water leaks between the bulkheads or in the hull, and see if the compartments and bilges are clean. All hulls should be hauled and the bottoms inspected and serviced in April and September. Wooden hulls operated in warm waters should be hauled for bottom scraping and painting in July and December, as well as in April and September. Wooden hulls operated in warm waters should be hauled for bottom service as soon as possible after any severe grounding or bottom scraping.
56	56	56	RIGGING (Boom) (Blocks) (Cable) (Hoist). Inspect these items to see that they are in good condition, correctly assembled, and secure; note whether the drive shaft joints, controls, or any lift linkage are excessively worn, and whether or not the lines or cylinders are leaking.
	56	56	<i>Serve and Clean.</i> Examine blocks for serviceability and cables for any damage or frayed spots. Clean and lubricate blocks and cables with cable lubricant. Also apply a few drops of oil to the pin joints of all lifting and control mechanism.

Tech. Insp.	Engine Running		
	1200 Hour	200 200	
	56	56	<i>Tighten.</i> Tighten all hoist mounting and assembly bolts securely. Tighten the piston rod packing nut and any pump and control valve gland nuts, taking care not to overtighten them, as this may score the shaft and cause leaks.
57	57	57	WIRING (Junction and Terminal Blocks) (Fuses and Spares). Observe all exposed electrical wiring and conduits to see that they are in good condition, well supported, and whether or not the wiring is securely connected to its terminals. Also make sure that all junction and terminal blocks and boxes are in good condition and secure, and that all necessary fuses and spares are in place and in good condition.
58	58	58	HEATERS, FANS, AND DEFROSTERS. Note whether or not these items are in good condition and secure. Turn the switches on to see that these items operate properly, and listen for any unusual noise in the heater or fan motors.
	58	58	<i>Special Lubrication.</i> Apply a few drops of light oil to the lubrication fittings of the heater and fan motor bearings.
59	59	59	PLUMBING, FIXTURES, ETC. See that these items are in good condition, correctly assembled, and securely mounted; note whether there are any indications of fluid leaks in the control valves or fluid lines. Examine all control valves, gauges, and floats; inspect valves to determine whether they are operating freely, not clogged or corroded, and in serviceable condition.
60	60	60	FIRE EXTINGUISHER SYSTEM (Tanks) (Valves) (Lines and Nozzles) (Mountings). Inspect the tanks and valves feeding the fire extinguisher system to determine whether they are in good condition and securely mounted and whether the tanks are fully charged. The charge may be determined on gas type extinguishers by weighing with a scale; on a liquid type, by shaking. Examine the control cables and handles to see that they are in good condition and free to operate at a moment's notice. Note whether all the lines and nozzles are in good condition and securely mounted and connected and whether the nozzles are clean and properly aimed at the points most likely to catch fire.
	60	60	If there is any indication that the nozzles are clogged by dirt or corrosion, disconnect the main feed line between the tank control valve and the nozzles, and apply compressed air cautiously. <i>Caution:</i> If the fire extinguisher tanks are not full, they should be reported for recharge or exchanged for fully charged tanks immediately. Any cylinder containing gas under high pressure should never be dropped, struck, handled roughly, or exposed to unnecessary heat.
	60	60	<i>Special Lubrication.</i> Apply a few drops of engine oil to all of the pulleys and guides through which the control cables operate.
	60	60	<i>Tighten.</i> Tighten all assembly and mounting bolts and screws.
61	61	61	PAINT AND MARKINGS. Examine the paint and markings on the entire craft; see that they are in good condition, paying particular attention to bright paint spots in the finish that might cause glare or reflection. Inspect craft markings and identification for legibility. Include identification plates, signs and their mountings, if furnished.
62	62	62	COMPASS (Fluid) (Lamp). Inspect the compass to see if it is in good condition and secure; look for low level or indications of bubbles in the fluid bowl. Fill the fluid bowl with ethyl alcohol if needed. Operate the compass lamp and switch to see that it operates properly.
63	63	63	TOW (Chain) (Cable) (Rope) (Block). Inspect provided towing lines and devices to see that they are in good condition, clean, and properly stowed. Tow chains, lines, and cables must be properly protected against rust when not in use. If snatch blocks are furnished, check to see that they are in good condition, properly lubricated and operate freely.
64	64	64	ANCHOR, HAND BILGE PUMP, AND BOAT HOOK. See that these are present, in good condition, securely mounted, or properly stowed. Operate the hand bilge pump in water to see that it functions properly.
65	65	65	TOOLS AND EQUIPMENT. Check against craft stowage list to see if all items are present, in serviceable condition and properly stowed or mounted. Pay particular attention to see that all tool-mounting brackets and straps are in good condition and secure; also, that tools with cutting edges are sharp. Sharpen if necessary. In tactical operations, any tools or equipment that are mounted on the outside of the craft and have bright or polished surfaces should be painted or otherwise treated to prevent glare or reflection.
			<i>Note:</i> Tools and equipment not in use should be treated with a rust preventive compound to prevent rust and to maintain tools in a serviceable condition.
66	66	66	FIRST AID KIT AND LIFE PRESERVERS. See that the items in the first-aid kit are present, in good condition, and properly packed. Report any deficiencies immediately. Inspect safety devices, such as life preservers, collapsible rafts and boats to see that they are in serviceable condition and complete with accessories. Report any shortage or deficiencies to the proper authority.

APPENDIX

GLOSSARY

- Accelerate.* To increase the speed of movement, such as increasing the speed of an engine.
- Advance.* Sometimes referred to as "lead, or angle of advance", meaning the distance ahead of top or bottom dead center of the piston as measured in degrees of crank travel.
- Air-bound.* A lubricating-oil or fuel-oil system may become air-bound when air enters the system through vents or leaks. The air, by being compressed by the fluid flowing through the lines, interferes with the continuous flow of the fuel and may cause the engine to stop running. In other cases serious damage to the engine may result because of lack of proper lubrication.
- Air-filter.* A device for filtering the air, before it goes into the engine, to prevent particles of dust from entering the engine.
- Air-starter.* A system whereby an engine is turned over by admitting compressed air into the cylinders.
- A.P.I.* American Petroleum Institute. An arbitrary scale used to designate the specific gravity of fuel oils. Diesel fuels usually range from 24 to 36 A.P.I. gravity.
- Atmospheric pressure.* The pressure of the atmosphere measured from absolute zero pressure. At sea level atmospheric pressure is about 14.7 lbs. per square inch, decreasing as the altitude increases.
- Atomize.* To reduce to extremely fine particles.
- Axially.* Parallel to the center line of a cylinder or shaft.
- Axis.* A center line. A line about which something rotates or about which it is evenly arranged.
- Babbitt.* An anti-friction metal used to line bearings.
- Back pressure.* The result of resistance to the normal flow of gases and liquids.
- Bore.* The interior diameter of an engine cylinder. (See "Stroke".)
- British thermal unit (B.T.U.).* A unit for measuring heat. One British thermal unit equals 778 foot-pounds of work (or energy). It represents the heat required to change the temperature of 1 pound of water through 1° Fahrenheit.
- Burning.* Commonly substituted for combustion, as late burning, meaning late or slow combustion.
- Bypass.* A separate passage which permits a liquid or gas to take a course other than normally used.
- Cam.* Wheel-like disk, attached to shaft, only a portion of which is circular, the remainder protruding beyond the circle. From the irregularity of the contour of the cam, corresponding motion is imparted to a valve or injector by means of tappet (the roller of which rests on the cam), push rod and rocker arm.
- Cam follower.* That part of the push rod that rubs, bears on or follows the cam.
- Camshaft.* The shaft which carries the various cams required for the operation of inlet valves, exhaust valves, and starting-air valves.
- Carbon.* One of the elements which when properly combined with oxygen will burn. Residual substance left after fuel oil or gasoline has burned is commonly called "carbon." This carbon usually contains non-combustible impurities such as dust taken into the engine with the air and also unburned carbon from the oil.
- Carbon dioxide.* A gas composed of molecules made up of one atom of carbon and two atoms of oxygen.
- Carbon monoxide.* A gas composed of molecules consisting of one atom of carbon and one oxygen. Combustion is not complete if carbon monoxide is present.
- Carbon residue.* The carbon remaining after evaporation of the volatile portion of a fuel oil by heating it in the absence of air under controlled test conditions. It is an indication of the amount of carbon that may be deposited in an engine.
- Centrifugal force.* The force acting on a rotating body which tends to throw it farther from the axis of its rotation.
- Cetane rating.* A system of numbers for indicating the ignition quality of Diesel fuels.
- Chamfer.* A beveled corner.

Check valve. A device that permits passage of a fluid or gas in one direction only. It stops (or checks) reverse flow.

Clearance. The space between a moving and a stationary part or between two moving parts. Clearance is usually allowed between two surfaces to provide for expansion, and contraction, and for lubrication.

Clearance volume. The amount of space confined within the engine cylinder and related parts when the piston is at its top dead center position.

Coefficient. A ratio; a known factor or quantity that is always constant.

Combustion. The rapid oxidation or combination of a combustible such as carbon, hydrogen and sulphur, with oxygen in the air.

Combustion chamber. The space within a cylinder in which the fuel mixture is burned.

Compression. Pressure developed within the cylinder as the piston moves from bottom to top center with all valves closed.

Compression-ignition. Ignition of a fuel charge by heat of the air in a cylinder, generated by compression of the air, as in the diesel.

Compression pressure. The amount of pressure resulting from the compression stroke of a piston when it has reached top dead center.

Compression ratio. A ratio expressing the extent to which a fuel mixture or air charge is compressed. It is a relationship between clearance and displacement volumes and is found as follows:

$$\frac{\text{Piston displacement} + \text{clearance volume}}{\text{Clearance Volume}} = \text{Compression Ratio}$$

Compression stroke. The stroke of the piston during which the air is compressed in the cylinder by the piston movement.

Compressor. The air "pump", which furnishes compressed air for starting the engine.

Concentric. Having a common center.

Condensation. The process by which a vapor is reduced to a liquid.

Connecting rod. That part which connects the piston to the crankshaft and which takes the thrust of expansion of the burnt gases. It changes reciprocating motion of the piston into rotary motion at the crankshaft.

Connecting-rod bearing. The bearing located in the large end of the connecting rod by which it is attached to the crankshaft.

Connecting-rod oil pipe. The passageway in the connecting rod by which the oil is taken to the piston pin.

Contraction. Becoming smaller in size. Usually, in metals, a result of cooling or a lowering of temperature.

Cooling water. The fluid which circulates through the jacket space of cylinders and cylinder heads to prevent excessive heating of the castings.

Craft. A term usually applied to small ships, including all boats, launches, tankers, tugs, ships, and vessels under the jurisdiction and responsibility of the Transportation Corps.

Crank. That part of the crankshaft which is in the form of a crank and crankpin. The connecting-rod is connected to the crank.

Crankcase. Lower part of the engine structure surrounding the working parts.

Crankpin. That part of the crank to which the connecting rod is connected.

Crankshaft. That part of the engine which transmits the reciprocating motion of the piston to the driven unit in the form of rotary motion. That part to which the connecting rod and flywheel are attached. That part which actually does the delivering of the power developed above the piston.

Crankshaft main bearing. That part of the shaft which revolves in the bearing placed in the crankcase.

Crankshaft pin bearing or journal. That part of the crankshaft on which the connecting rod is attached and rotates.

Crankshaft web. That part of the crankshaft that connects the crankpin with the main bearing of the crankshaft, also called crank arm or crank cheek.

Crown. Term often used to designate the top of an engine piston.

Cycle. The complete series of operations which occur until the original positions of all moving parts are restored and the operations start over again in regular order. In the 4-cycle, or 4-stroke cycle engine, this requires 4 strokes of the piston, hence the designation; in the 2-cycle engine only 2 strokes are needed to complete the cycle.

Cylinder. The cylindrical part of the engine in which the piston moves, and in which combustion takes place.

Cylinder block. A number of cylinder bores all cast in line and in one piece.

Cylinder bore. The part of the cylinder in which the piston slides or moves.

Cylinder head. The part which covers and seals the end of the cylinder and usually contains the valves.

Cylinder head stud. A threaded round piece of material, one end of which screws into the cylinder block; the other end has a nut screwed on it which holds the cylinder head in correct position.

Cylinder liner. A cylindrical lining that is pressed into the cylinder block and in which the piston slides.

Delivery stroke. The stroke of a pump during which the fluid in the pump is forced out of the cylinder.

Diesel. An internal-combustion engine differing from other internal-combustion engines in that its compression is high enough to cause combustion to be spontaneous.

Diesel cycle. A cycle of events which occur in Diesel engines similar to gasoline (Otto cycle) engines except that air without fuel is compressed to a high pressure. At the end of the compression stroke, fuel is injected into the hot compressed air and burns immediately.

Distillation. Separation of the more volatile parts of a petroleum oil from those less volatile by vaporization and, subsequently, condensation.

Dribbling. A characteristic of an injection nozzle in which the fuel seeps slowly from the nozzle tip.

Eccentric. A circle not having the same center as another within it. A device mounted off-center for converting rotary motion into reciprocating motion.

Echelon, First. The preventive maintenance performed by the user, wearer or operator of the equipment. Includes care, use, operation, cleaning, preservation and lubrication.

Echelon, Second. The maintenance operations performed by a maintenance platoon, or section, of the combat company, battalion, or regiment (*i.e.*, by the using organization). This maintenance unit carries a predetermined stock of parts called "Organizational Spare Parts Set," and has skilled mechanics, suitable for, and within the

scope of, the maintenance of its equipment in the forward areas.

Echelon, Third. The operations usually performed by mobile (light and medium) maintenance organizations attached to, designated for, or an organic part of troop units. (Includes Post and Port Shops).

Echelon, Fourth. The operations usually performed by an established pool, of variable numbers and types, of heavy maintenance and supply units, formed as a semi-mobile shop, serving an area. (Includes designated Post and Service Command Shops). Its main function is the rebuilding of items, usually from serviceable parts on hand.

Echelon, Fifth. The operations performed in fixed installations designated as Base Shops or Depots. It has equipment for the complete rebuilding of matériel. It manufactures items when no other source of supply is available.

Efficiency, volumetric. The ratio of the volume of air or fuel mixture actually taken into the cylinder to the volume of the piston displacement.

Efficiency, mechanical. The ratio between the brake horsepower (bhp) and the indicated or total horsepower (ihp).

Electrolyte. A solution of sulphuric acid and distilled water, normally have a specific gravity of 1.300 and used in storage batteries.

Energy. Capacity for doing work.

Engine. A machine which produces power to do work, particularly one that converts heat into mechanical power; the term "engine" should be used in referring to the power plant of a craft, and the term "motor" should be used in connection with electric motors.

Exhaust cam. The cam which controls the operation of the exhaust valve. The exhaust cam is part of the camshaft.

Exhaust gases. Products of combustion which are exhausted from the cylinder.

Exhaust manifold. The pipe that collects the burned gases as they are expelled from the cylinders.

Exhaust pipe. Piping through which exhaust gases from an engine pass out to the atmosphere.

Exhaust valve. The unit by which the burned gases are allowed to pass out of the exhaust manifold.

Exhaust pyrometer. An instrument to measure temperature of the exhaust, by the small electrical current developed at the junction of two dissimilar metals when exposed to heat.

Expansion period. The portion of the power stroke during which the combustion gases exert pressure on the moving piston, and expand while the pressure falls.

F.P.M. Abbreviation for feet per minute.

Filter cartridge. Element in filter through which lubricating oil or fuel oil passes and which retains the impurities of the oil.

Fit. A fit may be considered as the desired clearance between the surfaces of machine parts.

Flash point. The temperature, °F., at which oil must be heated before the oil vapor over the oil will ignite when a fire is passed across the oil's surface.

Fluctuations. Variations in value, such as of pressure, velocity, etc.

Flywheel. The wheel on the end of the crankshaft which gives the crankshaft momentum to carry the pistons through their stroke when no expansion is taking place above the piston.

Foot-pound. (ft-lb). Unit of measurement equivalent to the work of raising one pound vertically a distance of one foot or moving an object one foot against a resistance of one pound.

Frame. The part of an engine between the cylinders and bed plate.

Friction. The action between two bodies at the surfaces of contact, which opposes movement.

Fuel injection. The forcing of fuel oil into the combustion chamber of a Diesel engine by means of high pressure.

Fuel pump. A small pump for delivering fuel to the engine. A Diesel fuel pump operates at a fixed ratio to engine speed and may be of the constant volume or of the metering type.

Fulcrum. The support on which a lever turns.

G.P.M. Abbreviation for gallons per minute.

Gasket. Packing placed between two surfaces which must have a leak-proof joint.

Governor. On engines the governor is a device whereby the speed is held approximately constant regardless of the load, brought about by the governor altering the amount of fuel introduced into the cylinder.

Header. A pipe provided with branch connections. Similar to a manifold but of smaller size.

Heat. A form of energy.

Heat units. The unit of heat (1 British Thermal Unit).

Helical. A point rotating about a fixed axis and at the same time moving uniformly along the axis, is said to follow a helix, and its path is said to be helical. A thread on a bolt or nut is of helical form. Some gears are made with teeth of helical form to insure more continuous contact between the teeth.

Helix. A line shaped like a screw thread.

Horsepower. A unit for measuring power. It is the rate at which work is done. One horsepower is 33,000 foot-pounds per minute.

Horsepower, brake (BHP). Amount of net available power produced by an engine as measured at the crankshaft.

Horsepower, friction (FHP). The horsepower consumed by the engine in running itself; that is, the power lost within the engine due to its internal friction.

Horsepower, indicated (IHP). Total power developed by the engine; or brake horsepower (bhp) added to friction horsepower (fhp).

Hunting. Erratic engine operation; caused by the inability of a governor to respond accurately to changes in engine speed.

Hydraulics. The science of using liquids under pressure to do work.

Idling. Engine running at a very low speed with or without load.

Ignition. Fuel starts to burn.

Impeller. The rotating part of a blower or pump which imparts motion to air or a liquid by forcing it outward from the center of the part.

Impulse. Force produced by the combustion of fuel and used to drive the piston on the expansion stroke.

Inertia. The property of a body which causes it to persist in a state of rest or in uniform motion.

Injection pump. A pump used to inject fuel into the engine cylinder.

Inlet cam. That part of the camshaft that controls the operation of the inlet valve.

Inlet manifold. The pipe which conducts air into the cylinders.

Inlet valve. That unit which allows air to pass into the cylinders.

Intermittent. Occurring at intervals.

Internal combustion. In Diesel engines, the burning of fuel oil inside the engine cylinders by means of highly compressed air, which is at a sufficiently high temperature to ignite the oil. Combustion within a gasoline engine is also internal combustion.

Jacket. An outer metallic casting forming a space around the cylinder liners to permit the circulation of water for cooling purposes.

Jet. A metered opening in an air or fuel passage to control the flow of air or fuel.

Journal. The finished part of a shaft which rotates in or against a bearing.

Jumper. A water-pipe connection between a cylinder head and the cylinder jacket or the water-jacketed exhaust manifold; also called a "goose-neck."

Key. A square or rectangular piece of metal, usually steel, used to secure a collar or flywheel to a shaft.

Key-way. A machined slot in a shaft or hub of a wheel to take a steel key.

Laminated. Made of thin layers such as "laminated shims," "laminated cores," etc.

Laminated shims. A series of thin metallic sheets placed between two halves of a bearing to maintain a predetermined clearance between the bearing and shaft.

Lands. The portions of a piston between the grooves carrying the piston rings.

Liner. The inner, removable bore of the cylinder in contact with the piston.

Lubricant. Any liquid or grease employed to coat a surface upon which another surface rotates or slides, in order to reduce the friction.

Manifold. A common pipe with a number of inlets to, or outlets from, the several cylinders of an engine.

Mechanical injection. (See "Solid injection.")

Motor. Technically, an electric motor. (See "Engine.")

Muffler. Sometimes referred to as silencer. Used to diminish noise either of the intake or exhaust.

Needle valve. A long rod with a tip which seats against an outlet and prevents oil from entering the engine cylinder until the needle is lifted by a cam or otherwise.

Nitrogen. A gas that makes up approximately four-fifths of the atmospheric air. Nitrogen will unite with certain substances, but it does not give off heat in so doing.

Nozzle. The part of the injector or spray valve in which are located the holes through which the fuel is injected into the cylinder.

Oil filter. A device for removing impurities from lubricating oil or fuel oil by causing the oil to flow through cloth or fabric elements in the filter casing.

Oil pump. The unit which circulates the lubricating oil through the engine. Also the fuel-oil pump which keeps the fuel system full.

Oil ring. A ring located at the lower part of a piston to prevent an excess amount of oil from being drawn up into the piston during the suction stroke.

Oil way or oil groove. The passageway through which the lubricating oil flows. Grooves or passages cut in bearings for oil distribution.

Orifice. An opening of any kind. Usually refers to the hole in the spray nozzle.

Oil strainer. Device in which impurities are removed from lubricating oil or fuel oil by causing the oil to flow through closely spaced metal disks or ribbons assembled in a suitable casing.

Otto cycle. A cycle of four events which occur in a gasoline engine in the following order: Intake, Compression, Power, and Exhaust.

Outboard bearing. A bearing outside the engine proper, carrying an extension of the crankshaft.

Oxygen. A gas that is highly inflammable when mixed with certain other substances, such as carbon. It makes up about one-fifth of atmospheric air.

Packing. A material used to seal a joint against leakage.

Packing rings. Rubber rings used at the bottom of the cylinder liner to form a watertight joint.

Piston. A cylindrical part of an engine which reciprocates in the cylinder bore and transmits the force of the gas pressure exerted upon its crown, to the connecting rod and crank.

Piston crown. The top of the piston, same as piston head.

Piston head. The top of the piston or that part of the piston against which the combustion pressure acts.

- Piston pin.* A pin which rests in two bored holes in the piston and passes through the eye of the connecting rod to join the two together flexibly.
- Piston pin bearing.* The bearing either in the eye of the connecting rod or in the bored bosses of the piston, in which the piston pin rotates.
- Piston pin boss.* The part of the piston on the inside, through which the hole is made to allow the installation of the piston pin in the piston.
- Piston pin lock.* The device used to hold or lock the piston pin in the piston.
- Piston ring.* A split ring placed in the upper part of the piston to form a leakproof joint between the piston and cylinder wall. Piston rings are also found in the skirt of the piston.
- Piston-ring gap.* The space between the ends of the piston rings when they are in the cylinder bore.
- Piston-ring land.* The part of the piston on the outside surface located between the piston-ring grooves.
- Piston skirt.* That part of the piston below the piston ring grooves. That part of the piston in which is located the piston-pin hole.
- Piston stroke.* The movement of the piston from one end to the other of the piston travel in the cylinder bore. The piston stroke is equal to twice the throw of the crankshaft.
- Plunger.* The piston of a pump, such as a fuel-injection pump.
- Pneumatic control.* Control system operated by compressed air.
- Poppet valve.* A valve opened by the action of a cam and closed by a strong spring. This type of valve is used almost exclusively in the automotive industry.
- Port.* An opening, hole, or passage; also, side of vessel on left of a person who stands on board facing the bow (as opposed to "starboard").
- Pour point.* The lowest temperature, °F., at which oil will remain in the liquid state. Below this temperature the oil will congeal or assume a jelly-like composition.
- Power.* The capacity to do work.
- Precombustion chamber.* A chamber in the cylinder head of some engines into which the oil is sprayed, and where it is partly burned when mixing with the small amount of air present.
- Preignition.* Refers to ignition taking place before the designed time in an engine's operating cycle (before the spark in a gas engine); considered almost impossible in engines using fuel injection unless the timing is deranged.
- Pressure.* The force due to the action of a gas or liquid, in terms of pounds per square inch, or kilograms per square centimeter when metric measurements are employed.
- P.S.I.* Abbreviation for pounds per square inch.
- Push rod.* The rod moved by the cam and camshaft to operate the rocker arm on the top of the cylinder.
- Pyrometer.* An instrument for measuring temperatures, either by means of heat-produced expansion and movement of one of its parts (as in mechanical or direct-acting pyrometers) or by electrical currents generated in a thermocouple, as in the electric pyrometer.
- Radial.* Radiating from a common center, as the spokes of a wheel.
- Rebuild.* To restore a major item to a condition equivalent to its original state by the replacement of unserviceable subassemblies or assemblies and by repair. Includes welding, riveting, machining, fitting, aligning, balancing, assembly, and testing.
- Reclaimer.* An apparatus which treats dirty oil and makes it usable again.
- Reclamation.* Process of restoring, repairing and refabricating salvaged articles or components thereof.
- Rectilinear motion.* A motion in a straight line.
- Relief, compression.* A device which reduces the compression in a cylinder to make cranking easy.
- Relief valve.* A valve, usually held closed by a spring which is forced open when pressure in the connecting vessel rises above the desirable value.
- Repair.* To restore to a serviceable condition, such parts, assemblies, or sub-assemblies as can be accomplished without completely disassembling the assembly or sub-assembly, and where heavy riveting, or precision machining, fitting, balancing, or aligning is not required.
- Replace.* To remove an unserviceable part, sub-assembly, or assembly and replace it with a new, reconditioned, or rebuilt part, sub-assembly, or assembly.
- Rings, compression.* Piston rings placed in the

upper section of the piston barrel to seal against loss of compression and gas blowing.

Ring grooves. Grooves cut in the piston barrel to hold the piston rings.

Ring, oil. See Oil ring.

Ring, piston. See Piston ring.

Rocker arm. A lever usually mounted on a shaft on the cylinder head, which has one end resting on the valve-stem top and the other resting on a push rod, the motion of which lifts the rocker arm, which in turn, pushes the valve open.

Rocker-arm shaft. The shaft at the top of the cylinder which serves as a fulcrum on which the rocker arm moves to actuate the valve.

R.P.M. Revolutions per minute.

Rotary. Revolving or circular. Rotary motion is considered the opposite of linear reciprocating (up and down or back and forth) motion in power transfer.

Scavenging. The sweeping out of an engine cylinder, by piston movement or a blast of air, of all or most of the gaseous products of the preceding fuel combustion.

Seal. Any method of preventing leakage. Usually the word is used to describe a method of packing around a crankshaft when it extends outside the crankcase, to prevent oil leaking out of the crankcase.

Seat, valve. That part of the valve mechanism upon which the valve face rests to close the port.

Servo-motor. A small hydraulic motor for operating heavy control mechanisms.

Shaft. A round section of steel or iron, which has a rotating or revolving action. An example is the crankshaft of an engine.

Shaft horsepower, ship. Power applied to turning propeller shaft in marine installations.

Shell. A term used to designate the steel or bronze backing into which the babbitt of a shaft bearing is fixed. It may be considered as the bearing itself.

Shim. A thin sheet of metal or other material which is placed between the two halves of a bearing. When the bearing wears, removal of the shim brings the two bearing halves closer together and so compensates for wear.

Silencer. See Muffler.

Silent chain. A chain made of small pieces of

steel plate, joined together by small pins, which by engaging teeth on sprockets, enables one shaft to drive a second shaft.

Sludge. A tar-like formation in oil resulting from the oxidation of a portion of the oil.

Solid injection (also Mechanical or Pump injection). A method of forcing fuel charges into the combustion space of an internal-combustion engine by mechanical action or by direct pump pressure.

Specific gravity. Weight of a given volume of substance compared to that of an equal volume of chemically pure water at 4°C. (39.2°F.). Example: Pure commercial sulphuric acid has a specific gravity of 1.8 as compared to distilled water, which has a specific gravity of 1.00.

Spray valve. See Valve, spray.

Spring. A coiled piece of round steel which is used to close valves of an engine.

Stability. Ability of lubricating oil to stand up without physical change under severe operating conditions.

Starboard. See Port.

Stress. The forces exerted on, within, or by a body during either tension or compression.

Stroke. The distance a piston travels up or down inside a cylinder.

Suction stroke. (Also called Intake Stroke). The stroke of the piston during which, in a four-cycle engine, fresh combustion air is forced by atmospheric pressure into a space vacated by piston; if assisted by some type of pump or blower, this is called the supercharging period.

Sump tank. Storage or supply tank for lubricating oil or fuel oil.

Tachometer. An instrument for indicating rotative speed in terms of revolutions per minute.

Tappet. That portion of a valve operating mechanism which rides against the cam and lifts the valve or push rod; also termed "cam follower."

Temperature. The intensity (or degree) of heat.

Thermodynamics. The theory of changing heat into mechanical work.

Thermostat. A mechanism to convert expansion of heated metal or fluid into movement and power sufficient to operate small devices, control electric circuits or small valves, etc. Can be set to operate at definite temperatures.

- Throw or crankshaft.** The distance between the center of the crankpins and the center of the main bearing of the crankshaft. It is equal to half the stroke of the engine.
- Thrust.** A force exerted against an engine part, usually a shaft, tending to move it endwise.
- Timing.** With Diesel engines, timing is the angle made by the crank at either top or bottom dead center, where some valve either opens or closes.
- Timing chain.** A chain used to connect the crankshaft and camshaft, by which the camshaft is made to rotate.
- Tolerance.** An allowable variation in dimensions. For example: A standard measurement of .025 with a tolerance of minus .003 or plus .003 indicates that dimensions between .022 or .028 are allowed.
- Top dead center (T.D.C.).** This is the farthest point reached by piston in its movement away from the crankshaft, or toward the cylinder head in a vertical engine.
- Torque.** A twisting or wrenching effort. Torque is the product of force multiplied by the distance from the center of rotation at which it is exerted. For example: A force of 40 pounds applied on the end of a 1-foot pipe wrench would be 40 pounds \times 1 foot, or 40 foot-pounds of torque; on the end of a 2-foot pipe wrench, there would be 40 pounds \times 2 feet, or 80 foot-pounds of torque. This indicates why it is easier to unscrew a pipe coupling with the 2-foot wrench than with the 1-foot wrench, the torque incident to the 2-foot lever (wrench) being greater.
- Torsion.** The deformation in a body caused by twisting.
- Transfer pump.** A pump employed to force oil from storage to the small engine tank; also to force oil to fuel-injection pumps.
- Turbulence.** A high-velocity swirling of air, fuel vapor or a mixture of both within the combustion chamber or cylinder.
- Two cycle (properly two-stroke cycle).** An engine operating method utilizing a regularly repeated series or cycle of events, each cycle completed in two strokes of the piston, providing a power impulse per cylinder for each shaft revolution. One stroke includes the last part of the scavenging and all of the compression phases; the other, expansion, exhaust and the early part of the scavenging period.
- Vacuum.** A space devoid of matter; accordingly, one in which the pressure is zero.
- Valve, air.** A valve (usually composed of a disk and a stem) opened by a cam and closed by spring pressure, which admits air into the engine cylinder. Also called "inlet" or "intake" valve.
- Valve, exhaust.** A valve similar to an air valve (see above), operating to release exhaust gases from a cylinder.
- Valve guide.** That part in the cylinder block in which the valve stem moves.
- Valve, relief.** See Relief valve.
- Valve, spray.** A valve which allows the fuel charge to be sprayed into the engine cylinder.
- Valve spring.** The spring which is used to close the valve.
- Valve spring disk.** The part against which the valve spring bears.
- Vanes.** Baffles employed to deflect currents of air, gas, or liquids.
- Velocity.** The rate of motion or speed of a body at any instant.
- Venturi.** A tube with a narrowing throat or constriction to increase the velocity of the gas or fluid flowing through it.
- Viscosity.** Resistance to flow, measured by a number of systems (Saybolt-Furol, Saybolt-Universal, Engler, Redwood-Admiralty, etc.) and rated by the number of seconds (S) required for a definite quantity of liquid to flow through a standard orifice under stated test conditions. Thus, an oil rated as 100 S.S.U. would require 100 seconds to flow through the Saybolt-Universal Viscometer. Saybolt is a standard American instrument.
- Viscosity index.** A number given to a certain lubricating oil to indicate its performance, particularly as to change of viscosity with temperature variation, as compared to the average of two groups of test oils.
- Volatility.** Ability of a liquid to vaporize or turn into gas.
- Water jacket.** The space around the cylinder through which the cooling medium circulates.
- Working stroke (also power, combustion, or expansion stroke).** Piston stroke during which the combustion gases exert force on the moving piston.
- Wrist pin.** Same as "Piston Pin."

